DISEÑO DE HERRAMIENTAS DE APOYO A LA GESTIÓN DE ESPACIOS NATURALES PROTEGIDOS

El caso del servicio ecosistémico de recreación

Programa de doctorado en Ingeniería Civil

Ricardo Antonio Moreno Llorca

Directores:
Dr. Ángel Fermín Ramos Ridao
Dr. Víctor Jesús García Morales

UNIVERSIDAD DE GRANADA

Maquetación: Manuel Merino Ceballos
Portada: Inma García López
Autor: Ricardo Antonio Moreno Llorca

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"Vengo a terminar lo que empecé"

091

A mi padre, mi madre, mis hermanos y mis niños

A Alba

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Resumen

La Ley 2/1989, de 18 de julio, aprobó el Inventario de Espacios Naturales Protegidos de Andalucía y estableció medidas para su protección con el propósito de hacerla compatible con el desarrollo sostenible de los municipios que participaban de estos espacios. Previamente el gobierno andaluz había declarado los Parques Naturales de la Cazorla, Segura y Las Villas, Sierra de Grazalema, Cabo de Gata, María, Torcal de Antequera y Subbéticas y el Paraje Natural de las Marismas del Odiel. Actualmente, la Red de Espacios Naturales Protegidos de Andalucía (RENPA) está constituida por 310 espacios naturales protegidos, en función de sus valores y objetivos de gestión, así como de la normativa de declaración que los ampara. Del total de espacios protegidos, este trabajo de investigación se ha centrado en los parques nacionales (de los que hay tres declarados) y en los parques naturales (con un total de veinticuatro declarados en territorio andaluz).

La gestión de estos espacios protegidos se lleva a cabo a varias escalas de actuación. Desde acciones de gestión a nivel de toda la red, hasta decisiones concretas para un espacio protegido en algunos de los ámbitos competenciales de la administración. El objetivo principal de este trabajo es avanzar en el diseño de herramientas de apoyo a la toma de decisiones, así como en la evaluación de esas acciones a diferentes escalas espacio-administrativas.

El ámbito de la toma de decisiones y gestión de las áreas protegidas se caracteriza por una alta incertidumbre, complejidad e interacciones entre sistemas ecológicos y socioecológicos. En este contexto de dificultad para orientar las decisiones de los gestores, así como de evaluar los resultados de las acciones desarrolladas, la ciencia tiene un papel fundamental como generador tanto de conocimiento, como de herramientas que faciliten la gestión de espacios naturales.

A este planteamiento hay que añadir, además, el factor de la escala. Tanto las decisiones de gestión y su evaluación, como la generación de conocimiento y herramientas científicas se producen a diferentes escalas espacio-temporales, todas ellas fundamentales. Por ello se hace necesario acoplar la escala de los problemas de gestión a evaluar con la de la información y herramientas científicas que pretenden orientar al gestor en su labor.

Otro elemento que suele dificultar la colaboración entre el ámbito científico y la gestión en áreas protegidas se relaciona con los plazos y velocidad de actuación de cada uno de los actores. Mientras que el científico se suele caracterizar por unos plazos más dilatados para resolver grandes cuestiones que requieren, a menudo una velocidad de avance más lenta, el gestor se suele enfrentar a la resolución rápida de muchas cuestiones cotidianas y con poco margen de plazo para su resolución.

Por último, cuando se intenta abordar desde el ámbito científico un problema de gestión, una de las dificultades que se encuentran es de comunicación. Científicos y gestores utilizan un idioma diferente. Por ello, para que la transferencia de conocimiento científico sea eficaz, es de vital importancia que ambos actores intenten acoplar sus lenguajes y definan de manera conjunta las cuestiones a resolver. Este punto es de especial importancia para evitar que las cuestiones planteadas en estudios científicos resuelvan problemas reales o cuestiones aplicadas a un fin de toma de decisiones.

El presente trabajo de investigación se ha centrado en el diseño de herramientas, metodologías y análisis de datos que sirvan por un lado para orientar las decisiones de gestión y por otro para facilitar la evaluación de la gestión en espacios naturales protegidos a diferentes escalas de aplicación territorial y administrativa en el marco de un ciclo continuo de gestión adaptativa.

La protección de los ecosistemas y del paisaje se ha considerado positiva para el desarrollo ecológico y de la biodiversidad de estos espacios. Sin embargo, en muchos casos se ha interpretado como una amenaza al desarrollo socioeconómico de la población ligada a estos espacios. En el primer capítulo de este trabajo, en un enfoque global tanto en la gestión como en el número de espacios naturales incluidos, se ha evaluado el resultado de la declaración de la red de parques naturales en Andalucía, tras 20 años de su funcionamiento. Para ello, se ha llevado a cabo la adaptación de un índice sintético basado en distancias, para medir el cambio de bienestar socioeconómico. Este indicador ha servido para evaluar si la declaración de espacios naturales protegidos y los veinte años posteriores de su gestión, han sido beneficiosos o perjudiciales para los municipios que han formado parte de esta red de áreas protegidas. Se trata de una evaluación global pero necesaria para avanzar en la eterna cuestión de si la declaración de parte de un municipio como protegido, perjudica o beneficia desde el punto de vista socioeconómico a su población.

Los capítulos posteriores abordan aspectos de la gestión a una mayor escala. Aproximarse a una escala de más detalle en los problemas del gestor, implica desarrollar herramientas para ámbitos de gestión concretos. Desde el ámbito científico se emplea el concepto de servicio ecosistémico (beneficios que la sociedad obtiene de los ecosistemas) y que se clasifican en servicios de abastecimiento, regulación y culturales. El presente trabajo ha abordado la caracterización y valoración de servicios ecosistémicos culturales por un lado y por otro, en un caso de estudio más concreto, el análisis del servicio ecosistémico de recreación. Dentro de la categoría de servicios culturales, los recreativos son aquellos que forman parte del ocio y de un conjunto más amplio de prácticas culturales de las personas que interactúan con los espacios ambientales.

De esta manera, el capítulo segundo aborda la evaluación de los servicios ecosistémicos culturales en dos Parques Nacionales

emblemáticos de Andalucía: Sierra Nevada y Doñana. Se evaluó el uso datos provenientes de las de redes sociales para caracterizar los servicios ecosistémicos culturales que disfrutan los visitantes de dos parques nacionales. La posibilidad de obtener información de esta manera tan eficaz es especialmente interesante para los gestores en espacios naturales como Sierra Nevada, dónde los puntos de acceso para disfrutar de estos servicios son múltiples, y llegar de manera representativa a todos los visitantes es una tarea que requiere muchos más recursos económicos, humanos y de tiempo de los que los gestores pueden disponer. En base a un análisis de contenido de las fotos subidas a la red social Flickr, se ha caracterizado el tipo de visitante, así como el servicio ecosistémico cultural o experiencia basada en la naturaleza disfrutada por cada uno de ellos. Los resultados del uso de esta herramienta se contrastaron con las respuestas a encuestas on-line a los mismos usuarios, en dónde se les pedía información acerca del tipo de visitante que ellos se consideraban de las actividades llevadas a cabo. De esta manera se pudo evaluar en qué medida esta metodología era útil para tal fin y de qué manera optimizar los resultados.

El tercer capítulo consiste en la publicación de los datos que han servido de base para la investigación realizada en el segundo capítulo, en formato artículo de datos o data-paper. En el se describe la serie de datos utilizados y otros datos adicionales que fueron tomados y producidos a raíz del análisis de contenido de información obtenida de la red social de imágenes Flickr.

La segunda mitad del trabajo se ha centrado en el servicio ecosistémico de recreación en los en los centros de recepción e interpretación de visitantes en parques naturales de Andalucía. De esta manera, en el cuarto capítulo se desarrolla una escala de medición con indicadores subjetivos del servicio ecosistémico de recreación, a través de la percepción de la satisfacción y la calidad percibida del servicio recreativo en estos centros. En base a la metodología de incidentes críticos se obtuvieron los ítems que forman parte del conjunto inicial.

Este set fue depurado a través de un análisis factorial exploratorio y posteriormente confirmatorio (modelo de ecuaciones estructurales) hasta finalizar con una serie final de ítems agrupados en dimensiones o factores que conforman una escala de medición válida y fiable.

Finalmente, el quinto capítulo tiene como objetivo el uso de la escala generada anteriormente para orientar a la administración en la mejora de la gestión de los centros de visitantes. Para ello, se combinan métodos de valoración de los servicios ecosistémicos de forma económica (disponibilidad a pagar) y mediante indicadores subjetivos (escala de percepción de la calidad del servicio recreativo). Los resultados obtenidos asignan un valor económico a la tarifa por visitar el centro, junto con la valoración de la calidad percibida en el disfrute del servicio ecosistémico. El análisis conjunto de ambos resultados proporciona al gestor información sobre cómo mejorar la gestión de sus centros, definiendo las variables concretas que determinan una mejor valoración por parte del usuario. También informa al gestor de a qué niveles de calidad percibida el usuario está dispuesto o no a pagar una determinada cantidad por visitar el centro. De esta manera, el uso combinado de métodos de valoración de servicios ecosistémicos recreativos permite para hacer operativo el concepto de servicios ecosistémicos en cuestiones reales de gestión de áreas protegidas.

En conclusión, los diferentes capítulos que conforman el presente trabajo abordan, desde una perspectiva global hasta una escala de detalle, la generación de metodologías y herramientas que pueden ayudar al gestor a evaluar la gestión en los espacios protegidos, así como a obtener información relevante de manera eficaz para gestionar los servicios ecosistémicos culturales, a orientar la toma de decisiones en estos servicios. Igualmente facilitan la evaluación de los resultados de sus decisiones en ámbitos concretos como en el caso del servicio ecosistémico de recreación en centros de recepción e información de los espacios naturales protegidos.

Abstract

Law 2/1989 of 18 July 1989 approved the Inventory of Protected Natural Areas of Andalusia and established measures for their protection with the aim of making them compatible with the sustainable development of the municipalities that participate in these areas. Previously, the Andalusian government had declared the Natural Parks of Cazorla, Segura and Las Villas, Sierra de Grazalema, Cabo de Gata, María, Torcal de Antequera and Subbéticas and the Paraje Natural de las Marismas del Odiel. Currently, the Andalusian Network of Protected Natural Areas (RENPA) is constituted by 310 protected natural areas, according to their values and management objectives, as well as the declaration regulations that protect them. Of the total number of protected areas, this research work has focused on the national parks (of which there are three currently declared) and the natural parks (with a total of twenty-four declared in Andalusian territory).

The decision-making and management of protected areas is characterised by high uncertainty, complexity and interactions between ecological and socio-ecological systems. In this context of difficulty in guiding the decisions of managers, as well as in evaluating the results of the actions developed, science has a fundamental role as a generator of both knowledge and tools that facilitate the management of natural areas.

In addition to this consideration, there is also the factor of scale. Both management decisions and their evaluation, as well as the generation of knowledge and scientific tools, take place at different spatio-temporal scales, all of which are fundamental. It is therefore necessary to match the scale of the management problems to be assessed with that of the information and scientific tools that are intended to guide the managers in their work.

Another factor that tends to interfere with collaboration between

the scientific and management spheres in protected areas is related to the timeframes and timming. While the scientist is usually characterised by longer deadlines for resolving major issues that often require a slower advance speed, manager is usually confronted with the urgent resolution of many day-to-day issues with little time to resolve them.

Finally, when trying to deal with a management problem from a scientific point of view, one of the difficulties they face is about communication. Scientists and managers use a different language. Therefore, for the transfer of scientific knowledge to be effective, it is crucially important that both actors try to match their languages and jointly define the issues to be resolved. This point is particularly necessary in order to prevent the questions raised in scientific studies from resolving real problems or questions applied for decision-making purposes.

This research work has focused on the design of tools, methodologies and data analysis to guide management decisions and to facilitate the evaluation of management in protected natural areas at different scales of territorial and administrative application within the framework of a continuous cycle of adaptive management.

The ecosystems and landscape protection has been considered positive for the ecological and biodiversity development of these areas. However, in many cases it has been interpreted as a threat to the socio-economic development of the population linked to these areas. In the first chapter of this work, in a global approach to both management and the number of natural areas included, the result of the declaration of the network of natural parks in Andalusia has been evaluated, after 20 years of its existence. To this end, a synthetic index based on distances has been adapted to measure the change in socio-economic well-being. This indicator has been used to evaluate whether the declaration of protected natural spaces and the subsequent twenty years of their management have been beneficial or detrimental to the municipalities

that have formed part of this network of protected areas. This is a global evaluation, but it is necessary in order to make progress on the eternal question of whether the declaration of part of a municipality as protected is detrimental or beneficial to its population from a socio-economic point of view.

Subsequent chapters address aspects of management on a larger scale. Approaching the manager's problems at a more detailed scale involves developing tools for specific management domains. The scientific approach uses the concept of ecosystem services (benefits that society obtains from ecosystems), which are classified into provisioning, regulating and cultural services. This paper has addressed the characterisation and valuation of cultural ecosystem services on the one hand, and on the other, in a more specific case study, the analysis of the ecosystem service of recreation. Within the category of cultural services, recreational services are those that form part of leisure and of a broader set of cultural practices of the people who interact with environmental spaces.

Thus, the second chapter deals with the evaluation of cultural ecosystem services in two emblematic national parks in Andalusia: Sierra Nevada and Doñana. The use of social network data to characterise the cultural ecosystem services enjoyed by visitors to two national parks was evaluated. The possibility of obtaining information in this efficient way is especially interesting for managers in natural areas such as Sierra Nevada, where the access points to enjoy these services are multiple, and reaching all visitors in a representative way is a task that requires much more economic, human and time resources than managers can afford. Based on a content analysis of the photos uploaded to the Flickr social network, we characterised the type of visitor, as well as the cultural ecosystem service or nature-based experience enjoyed by each of them. The results of the use of this tool were contrasted with the answers to on-line surveys of the same users, where they were asked for information about the type of visitor they considered themselves to

be to the activities carried out. In this way it was possible to evaluate to what extent this methodology was useful for this purpose and how to optimise the results.

The third chapter consists of the publication of the data that formed the basis of the research carried out in the second chapter, in the form of a data-paper. It describes the series of data used and additional data that were collected and produced as a result of the content analysis of information obtained from the Flickr image social network.

The second half of the work focuses on the ecosystem service of recreation in visitor reception and interpretation centres in natural parks in Andalusia. In this way, the fourth chapter develops a measurement scale with subjective indicators of the ecosystemic service of recreation, through the perception of satisfaction and the perceived quality of the recreational service in these centres. Based on the methodology of critical incidents, the items that form part of the initial set were obtained. This set was refined through an exploratory and then confirmatory factor analysis (structural equation modelling) until a final set of items was obtained, grouped into dimensions or factors that make up a valid and reliable measurement scale.

Finally, the fifth chapter aims to use the previously generated scale to guide the administration in improving the management of visitor centres. To this end, methods of valuing ecosystem services are combined in an economic way (willingness to pay) and by means of subjective indicators (scale of perception of the quality of the recreational service). The results obtained assign an economic value to the fee for visiting the centre, together with the valuation of the perceived quality of enjoyment of the ecosystem service. The joint analysis of both results provides the manager with information on how to improve the management of its centres, defining the specific variables that determine a better valuation by the user. It also informs the manager at what levels of perceived quality the user is willing or unwilling to pay a certain amount to visit

the centre. In this way, the combined use of valuation methods for recreational ecosystem services allows to operationalise the concept of ecosystem services in real protected area management issues.

In conclusion, the different chapters that compose this work address, from a global perspective to a detailed level, the generation of methodologies and tools that can help the manager to evaluate the management of protected areas, as well as to obtain relevant information in an effective way to manage cultural ecosystem services, to guide decision-making in these services. They also facilitate the evaluation of the results of their decisions in specific areas, as in the case of the ecosystem service of recreation in reception and information centres in protected natural areas.

Capitulo 0

Introducción, objetivos y metodología

Introducción

La gestión de los espacios naturales es una tarea compleja dada la variedad de áreas que la conforman y la complejidad de la toma de decisiones en un contexto de falta de conocimiento en profundidad del comportamiento de los ecosistemas y de las interacciones de la sociedad con ellos (Acreman, 2005; Zamora and Oliva, M, 2022).

El ámbito científico y de gestión de estos espacios tienen como reto avanzar en una colaboración más estrecha y en superar las dificultades de generación y traslación de conocimiento científico de una forma efectiva para que pueda ser útil al tomador de decisiones (Enquist et al., 2017). Estas dificultades (diferentes lenguajes, planificación temporal, canales de comunicación, etc.) se pueden sintetizar en que ambos agentes trabajan en diferentes escalas temático-espacio-temporales, que resulta necesario acoplar para conseguir una transferencia de conocimiento efectiva.

El presente trabajo de investigación se ha centrado en el diseño de herramientas, metodologías y análisis de datos que sirvan por un lado, para orientar las decisiones de gestión y por otro para facilitar la evaluación de la gestión en espacios naturales protegidos a diferentes escalas de aplicación territorial y administrativa en el marco de un ciclo continuo de gestión adaptativa.

El papel de las escalas temático-espacio-temporales en la interfaz ciencia-gestión

En nuestro estudio, trabajamos bajo el enfoque de ecología traslacional en el que científicos y gestores cooperan en la definición de la pregunta a resolver y la forma de obtener resultados útiles para la gestión con un procedimiento científico. Para ello, junto con los gestores de los espacios se han definido las cuestiones a responder desde el ámbito científico, la metodología a emplear, los resultados esperados en base al análisis de las diferentes escalas en las que se planteaba el problema de gestión.

Escala temática

Definir la escala temática significa delimitar con exactitud la problemática de gestión a resolver (Múnera-Roldán et al., 2020). Concretar previamente este ámbito es importante por diversos motivos. Primero, la cuestión a estudiar va a determinar la metodología científica a seguir para la resolución del problema (Price et al., 2012). De esta manera, una cuestión de escala general como se presenta en el capítulo dos de este trabajo, requiere una metodología de estudio que integre muchos aspectos diferentes. En este capítulo nos preguntamos si la declaración y gestión de los espacios naturales de Andalucía ha mejorado o empeorado significativamente la calidad de vida de los habitantes de los municipios que forman parte de estos espacios. Segundo, evaluar conceptos tan globales como este, requiere el uso de indicadores sintéticos de ámbito subjetivo que sean científicamente válidos (Ezebilo and Mattsson, 2010). Al igual, en el caso de análisis de problemas de gestión más concretos desde el punto de vista temático, como es el caso de los capítulos tres y cuatro, requieren metodologías e indicadores que midan los aspectos concretos que los gestores necesitan saber para orientarlos en su toma de decisiones. En este caso, en que se evalúan los parámetros de los servicios ecosistémicos recreativos que se disfrutan en los centros de visitantes de espacios naturales, se ha tenido que generar y validar una escala de medición exprofeso para conocer cómo los usuarios valoran una sección de gestión tan concreta.

Escala espacial

En muchos casos, el motivo de que un estudio científico no pueda servir de orientación para la toma de decisiones es que la escala espacial de la investigación y la del problema de gestión no coinciden (Enquist et al., 2017; Root-Bernstein and Jaksic, 2017). Por ello, en este trabajo la escala espacial, que se traduce en los espacios naturales a incluir en el estudio, tanto en número como en tipología, ha sido definida de manera conjunta con los gestores correspondientes en cada caso. En el

capítulo uno de este trabajo se incluyeron parques naturales y parques nacionales declarados hasta la fecha del estudio, cubriendo la totalidad del territorio andaluz, en concordancia con la pregunta a responder. En el capítulo dos, cuyo objetivo era analizar hasta qué punto las redes sociales podían ayudar a los gestores de los parques nacionales a diagnosticar las actividades realizadas y caracterizar a sus visitantes, la escala espacial de estudio se ajustó a los parques nacionales cuyos gestores estaban interesados en analizar la cuestión. Respecto a los capítulos tercero y cuarto, con los centros de visitantes como objeto de estudio, la selección de centros y de áreas a incluir se hizo según el criterio conjunto de los científicos y del jefe de servicio encargado de la gestión de uso público en Andalucía.

Escala temporal

En otras ocasiones el desacople de la escala temporal entre la actividad investigadora y el problema de gestión a resolver es un □gap□ que dificulta una transferencia efectiva de conocimiento científico (López-Rodríguez et al., 2015; Löschner et al., 2016). Por ello es muy importante que la definición del ámbito temporal del estudio sea conjuntamente decidida. El estudio llevado a cabo en el capítulo uno requiere comparar la situación social en la fecha de la declaración y transcurridos los años necesarios para evaluar el efecto del funcionamiento de los espacios naturales en el bienestar de la población. El segundo capítulo nos permitió tomar todas las fotos de la red social subidas hasta la fecha para cubrir lo mas posible el rango temporal de los visitantes y de sus actividades. En el caso de que se hubiera querido obtener información de una franja concreta por parte de los gestores, la escala temporal del estudio debe de ajustarse a esa necesidad. Los capítulos tres y cuatro se han desarrollado en un momento concreto de tiempo con vocación de tener que irse actualizando cada cierto periodo para observar cambios en la percepción de los visitantes del servicio recreativo en centros de recepción e información, ya que es una información dinámica.

Objetivos

El objetivo general de este trabajo de investigación es avanzar en el desarrollo de herramientas de evaluación de la gestión de espacios naturales protegidos y de ayuda a la toma de decisiones en ámbitos concretos de actuación. De esta manera, este objetivo se ha llevado a la práctica en las diferentes escalas temático-espacio-temporales anteriormente descritas, concretándose así los diferentes objetivos específicos:

Evaluar el efecto de la declaración de la red de espacios protegidos de Andalucía y de su gestión en las dos primeras décadas de funcionamiento sobre el bienestar de la población

Tras la declaración de la red de espacios naturales protegidos de Andalucía en 1989 y su posterior gestión, este objetivo busca dilucidar qué efecto han tenidos estos espacios en los habitantes de los municipios que forman parte de ellos, transcurridos 20 años de funcionamiento. El objetivo era analizar si el índice de bienestar de la población ha aumentado en estos municipios. En caso positivo, comparar este indicador con los municipios que no forman parte de estos espacios, para ver en qué grupo de municipios el crecimiento ha sido mayor.

Desarrollar una metodología de caracterización de los visitantes a los parques nacionales en Andalucía, así como de los servicios ecosistémicos culturales que disfrutan en ellos en base a la información que aportan las redes sociales

La caracterización de los visitantes y de sus actividades en los espacios naturales protegidos suponen un reto en términos de recursos humanos económicos y de medios materiales para los gestores de estos espacios. Por ello se pretende crear una metodología para automatizar esta

tarea, en base al análisis de los datos que pueden aportar las redes sociales. Igualmente se comparan los resultados de esta metodología con información obtenida directamente de los visitantes a través de encuestas.

Publicar los datos de la investigación sobre el uso de redes sociales para la caracterización de los visitantes y sus actividades en los parques nacionales

En el ámbito científico, la publicación de los datos recopilados y analizados en los trabajos de investigación es cada vez mas necesaria, no solo en términos de transparencia, sino para poner en manos de la sociedad la información que se ha levantado gracias a sus recursos. Además, de esta manera se puede facilitar que otros investigadores puedan acceder a ellos para desarrollar nuevos trabajos. Por ello el objetivo era publicar estos datos en formato de artículo o data-paper.

Desarrollar una escala fiable y válida para evaluar a través de indicadores subjetivos el servicio ecosistémico de recreación en los centros de visitantes de los espacios naturales protegidos

La gestión de los centros de recepción, información y actividades de educación ambiental en los espacios naturales protegidos se ha convertido en un área clave de gestión, dado el aumento constante de los visitantes en estos espacios. El objetivo era desarrollar una escala fiable y válida que aporte al gestor el conocimiento de las variables más determinantes en el valor que el visitante le confiere a la visita de estos centros. Se pretende que el gestor conozca cuales son estas variables y disponga de un instrumento para conocer el estado de estas variables en cada uno de sus centros como información para mejorar su gestión.

Conocer el valor que los visitantes atribuyen a los servicios ecosistémicos recreativos en los centros de visitantes, a través de la combinación de métodos subjetivos y económicos, con objeto de obtener información útil para la gestión de estos equipamientos

El principal objetivo de esta parte del trabajo era crear valor añadido al instrumento en forma de escala generado en el anterior objetivo. De esta manera, el uso combinado de métodos de valoración subjetiva (a través de esa escala) y de valoración económica pretende que el gestor tengo información adicional para la toma de decisiones en el diseño y funcionamiento de los centros de visitantes.

Metodología

Capitulo uno: evaluación de la declaración y gestión de espacios naturales en Andalucía a través de un indicador sintético de bienestar de la población

La protección de espacios naturales conlleva la limitación de las actuaciones humanas en el uso de los recursos y en la implantación de nuevas infraestructuras. Esta limitación suele provocar en la población afectada por la declaración una reacción contraria por suponer un freno a su desarrollo económico y por ende a su bienestar.

En Andalucía la protección de espacios naturales bajo la figura de parques naturales cuenta con una experiencia de más de tres décadas. El objetivo de este capítulo es evaluar cómo ha influido la declaración y la gestión de estos espacios naturales en la evaluación del bienestar en los municipios que tienen gran parte de su territorio en áreas protegidas.

El concepto de bienestar es abstracto y dinámico. La evolución de lo que se conoce por bienestar ha marcado el cambio de los diferentes métodos para medirlo. De esta manera, inicialmente dominaba un enfoque económico del término que asumía que, a mayores ingresos, mayor bienestar. Uno de los indicadores económicos sintéticos más conocidos para la medición del bienestar es el de Daly & Cobb (Daly & Cobb, 1989)

Otros indicadores parten de esta perspectiva para ampliar el concepto con variables que incorporan alguna dimensión más, aparte de la económica. Ejemplos de estos son el IDH (PNUD, 1990) o indicadores de bienestar desarrollados por otros autores (Berenger & Verdierchouchane, 2007; Kabeer, 1996; Murias, Martinez, & Miguel, 2006).

Posteriormente esta concepción del bienestar evoluciona hacia un concepto más amplio en el que es preciso incorporar una serie de dimensiones sociales. Esta evolución se desarrolla siguiendo dos líneas diferentes. Una de ellas dentro de la psicología, donde toma protagonismo la componente de sensación personal de felicidad y de satisfacción con su vida como determinantes del bienestar seguida por diferentes autores (Diener, 2012; Ganglmair-wooliscroft, 2008; Rodriguez-Blazquez et al., 2011; Ryan & Deci, 2001; Veenhoven, 2004). El Índice Internacional de Bienestar (IWI) es probablemente el indicador de bienestar subjetivo más utilizado y una de las contribuciones de la psicología al estudio de la calidad de vida (Renn et al., 2008).

Por otro lado, se desarrolló el estudio del bienestar estableciendo una serie de dimensiones que son analizadas desde la escala social (no individual) que puede incluir componentes tanto objetivas como subjetivas. Dentro de esta lectura aparecen diferentes enfoques que incorporan estas dimensiones al constructo del bienestar.

Uno de ellos es el basado en las capacidades (Nussbaum & Sen, 1993), empleado en estudios posteriores (Distaso, 2007). Sen & Nussbaum defienden que el bienestar no depende únicamente de los bienes que se tengan sino de las capacidades o posibilidades reales de las personas para llevar a cabo acciones que los lleven al bienestar. Su propuesta establece dos rangos de medición: uno de ellos las capacidades que resultan más difíciles de medir (ej. capacidad de realizar estudios superiores) y otro conformado por los funcionamientos (acciones realmente llevadas a cabo, como por ejemplo número de universitarios), que se constituyen como subrogados de aquellas.

Otra perspectiva del bienestar se basa en las necesidades humanas. Según este enfoque, en la medida en que las necesidades humanas estén satisfechas, su nivel de bienestar será mayor. Este enfoque ha sido seguido en sus determinaciones del bienestar por diversos autores (Clarke, 2005; Costanza et al., 2007). Dentro de ella se diferencian dos vías diferentes: la medición objetiva que define necesidades básicas a satisfacer (Doyal & Gough, 1991; Streeten, 1981) y la medición subjetiva que incluye las valoraciones personales a través de satisfactores (Nax-Neef, Elizalde, & Hopenhayn, 1986).

La inclusión de un número alto de variables para medir el bienestar implica que su medición se haga a través de un constructo (indicador sintético), que se desglosa en una serie de dimensiones definidas cada una de ellas por una sucesión de variables parciales. Por lo tanto, se trata de un indicador sintético que se determina por agregación de todos los indicadores parciales que lo componen (Distaso, 2007).

Para ello, se pueden utilizar diferentes técnicas de agregación de variables en un único indicador sintético: suma aritmética (PNUD, 1990), media ponderada (Zarate, 1988), análisis factorial (Berenger & Verdierchouchane, 2007; Haq, 2009), análisis envolvente de datos (Murias et al., 2006) y métodos basados en el concepto de distancia.

Dentro de los indicadores sociales, no existe, una metodología aceptada para determinar las áreas y subáreas que deban establecerse (Pena, 2009). Así, en todos los estudios aparecen comúnmente dominios básicos, con diferentes denominaciones: educación, salud, trabajo, vivienda, tiempo libre y ocio, renta o riqueza, seguridad, entorno físico, entorno social (ver Chasco & Sánchez, 2013, para un resumen). Los distintos autores suelen añadir a estos dominios básicos alguno más, según la finalidad perseguida y la disponibilidad de datos (Pena, 2009).

Con objeto de seleccionar el mejor método para evaluar la evolución del bienestar en los municipios incluidos en los espacios naturales protegidos, en este estudio usamos un método basado en la distancia llamado DP2 (Pena, 1977). Este método ha sido utilizado en estudios similares (Cuenca, Rodríguez, & Navarro, 2010; Montero, Chasco, & Larraz, 2010; Rodríguez & Salina.; Somarriba & Pena, 2008; Zarzosa & Somarriba, 2012). El indicador sintético de distancia DP2 es una metodología definida por Pena (Pena, 1977) concretamente para calcular el bienestar social de un conjunto de regiones en un instante dado de tiempo, o de una región individual en distintos momentos de tiempo, lo cual lo hace idóneo para evaluar la evolución de este indicador en la escala temporal del estudio.

Capitulo dos: Caracterización de los servicios ecosistémicos culturales y de los visitantes a parques nacionales de Andalucía a través de datos de redes sociales

Es necesario desarrollar vías para que la ciencia informe la formulación de políticas medioambientales y las decisiones de gestión. Se requiere un compromiso colectivo para aplicar los conocimientos científicos a decisiones concretas que tengan como objetivo resolver los problemas medioambientales. Muchos de los retos relacionados con la traslación del conocimiento de la ciencia a los gestores están relacionados con la brecha existente entre el mundo científico, donde se definen, analizan

y publican las cuestiones de investigación, y el mundo de la gestión, donde se toman las decisiones en el mundo real (Enquist et al., 2017). En este sentido, el marco conceptual de los servicios ecosistémicos se ha convertido en un lenguaje que tiende puentes entre la ciencia y la gestión que permite integrar los ecosistemas (medio ambiente) y el bienestar humano (sociedad). Esta integración está facilitando la toma de decisiones en la gestión de los espacios naturales basada en el conocimiento científico (Fisher et al., 2009).

Los servicios culturales de los ecosistemas (CES) son los beneficios no materiales que las personas obtienen de los ecosistemas (MEA, 2005). Debido a su intangibilidad, los servicios culturales de los ecosistemas son especialmente difíciles de poner en práctica en la gestión de las áreas protegidas. En consecuencia, la incorporación de los CES en la toma de decisiones ha sido mínima en comparación con los servicios ecosistémicos (SE) más tangibles (Ament et al., 2017). A pesar de ello, los CES son los servicios ecosistémicos más valorados por los visitantes en las áreas naturales (Maestre-Andrés et al., 2016).

El término que la administración acuña para el ámbito de gestión de los CES es el de uso público. El uso público, se entiende como "*el conjunto de actividades recreativas, sociales, educativas o culturales que puede realizar el ciudadano en los espacios naturales con intención de disfrutar y conocer su patrimonio*" (Consejería de Medio Ambiente, 2007).

El seguimiento de la dinámica de los visitantes y de los servicios culturales que disfrutan en la naturaleza es una dimensión importante en la gestión de la conservación de las áreas protegidas.

Los CES disfrutados en los espacios naturales se han estimado tradicionalmente a partir de métodos de preferencia declarada (por ejemplo, cuestionarios), que suelen ser costosos y limitados en el espacio geográfico (Bragagnolo et al., 2016). Con la aparición de la

conservación digital (Van der Wal & Arts, 2015), el "big data" de las redes sociales se han visto como una forma alternativa de inferir sobre las interacciones entre la naturaleza y el ser humano, como el seguimiento de los visitantes (Tenkanen et al., 2017; Walden-Schreiner et al., 2018) o la recreación basada en la naturaleza (Jepson & Ladle 2015). El análisis de las fotos publicadas y compartidas en plataformas de medios sociales, como Flickr, ha recibido especial atención (Di Minin et al., 2015; Ladle et al., 2016; Thiagarajah et al., 2015). Esto se debe a que el análisis del contenido de las redes sociales permite a los científicos evaluar y cartografiar las interacciones entre la naturaleza y el ser humano, a múltiples escalas y resoluciones y de forma rentable y directa (Richards & Friess, 2015).

En este capitulo se aborda el análisis de hasta qué punto la información de las redes sociales puede ayudar a los gestores de espacios naturales protegidos a monitorear y caracterizar a los visitantes y los servicios ecosistémicos culturales que desarrollan en las áreas que ellos gestionan.

Capítulo tres: publicación de datos del estudio de caracterización de visitantes y servicios ecosistémicos culturales basado en datos de redes sociales

La publicación de los datos utilizados para llevar a cabo un trabajo de investigación, más allá de ser incluidos como material suplementario, es un ejercicio cada vez más común entre la comunidad científica.

El conjunto de datos publicados, proporciona información georreferenciada para la evaluación de los servicios culturales de los ecosistemas en la Reserva de la Biosfera de Sierra Nevada (sur de España). Los datos se recogieron en el marco del proyecto europeo ECOPOTENTIAL, centrado en la observación terrestre de los servicios de los ecosistemas. El conjunto de datos comprende 778 registros que

expresan los resultados del análisis de contenido de las fotos de las redes sociales publicadas en Flickr. El conjunto de datos se ilustra en este documento de datos con mapas de densidad para diferentes tipos de información.

Capítulo cuatro y cinco: valoración del servicio ecosistémico de recreación en centros de visitantes de espacios naturales protegidos a través de indicadores subjetivos y económicos

Entre los servicios culturales, la recreación y la educación ambiental son los SE en los que los gestores de los espacios protegidos tienen más capacidad de actuación.

La recreación es uno de los servicios de los ecosistemas identificados por la Evaluación de los Ecosistemas del Milenio de las Naciones Unidas (2005) y está relacionado con el desplazamiento del usuario a los espacios naturales (Costanza, 2008) y es posible gracias a ciertas características del ecosistema que la sociedad valora y elige para pasar parte de su tiempo y realizar actividades en la naturaleza. En este servicio, las infraestructuras, las instalaciones complementarias y la accesibilidad son importantes para posibilitar la experiencia recreativa y, por tanto, su uso (Goossen & Langers, 2000).

La recreación ha sido un gran objeto de estudio y se considera uno de los servicios culturales más importantes (Valck et al., 2015). Los servicios de recreación y ecoturismo han crecido significativamente en los últimos años (Buckley, 2009), y se describen como uno de los sectores económicos con mayor crecimiento.

Por ello, los gestores de los espacios naturales protegidos tienen cada vez mayor interés en mejorar y completar la oferta de servicios culturales de recreación en los ámbitos de su competencia.

Dado el interés del equipo de gestores en focalizar el estudio en los servicios recreativos que se prestan en los centros de visitantes, para entender qué factores son los más importantes para sus usuarios, se ha llevado a cabo una valoración combinada entre indicadores subjetivos e indicadores de estimación económica.

Los centros de visitantes son un tipo de equipamientos de recepción de los visitantes en los espacios naturales protegidos. Estos equipamientos son un punto de referencia de uso público en el espacio natural. Están destinados a prestar fundamentalmente los servicios de: información y difusión relacionada con la RENPA; orientación para la visita del espacio natural; promoción de actividades y servicios; desarrollo de programas de actividades vinculados al uso público y educación ambiental; promoción y comercialización de productos vinculados a la RENPA (Consejería de Medio Ambiente, 2007). De esta manera, los centros de visitantes se convierten en instrumentos para la co-creación de servicios ecosistémicos de recreación. Esto quiere decir que existen una serie de interacciones con la naturaleza por parte de los visitantes con los valores ambientales que los espacios naturales ofrecen, que no se pueden llegar a disfrutar sin infraestructuras y servicios que ofrecen estos centros.

Una de las tareas llevadas a cabo es la validación de una escala para medir, a través de indicadores subjetivos de calidad percibida, ha sido el diseño de una escala validada de medición de la satisfacción en el disfrute de los servicios ecosistémicos de recreación en los centros de visitantes.

El trabajo ha desarrollado en dos etapas diferentes: selección de ítems a través de la técnica de incidentes críticos y por otro lado la validación de la escala.

En un primer paso, la recopilación de los ítems se llevó a cabo mediante la realización de entrevistas estructuradas y de cuestionarios

acerca de las opiniones de los visitantes sobre la visita a centros de información e interpretación de los espacios naturales a lo largo de un año. Una vez obtenidos los ítems, se procedió a la validación de la escala. Se llevó a cabo una segunda encuesta a través de un cuestionario formado por estos ítems. El resultado final de esta primera parte consiste en una escala valida y fiable para medir la satisfacción de los usuarios de uso público cuando visitan los centros de recepción e información de los espacios naturales protegidos. La escala final cuenta con una validez contrastada, es fiable y presenta un buen ajuste. Un instrumento de medida es válido cuando mide el concepto para el que se diseñó y no otro diferente. Por otra parte, esta medida será fiable cuando mida un mismo concepto. La fiabilidad, por lo tanto, es una condición necesaria pero no suficiente para la validez de una medida. El ajuste del modelo se ha evaluado a tres niveles: medidas globales de forma absoluta, en forma incremental, y en forma parsimoniosa.

La escala propuesta en este trabajo supone una muy buena herramienta para la medición de la calidad del uso público en los centros de atención a los visitantes de los espacios naturales protegidos. El estudio establece tres dimensiones para la medición de la calidad de servicio: Información, instalaciones y atención del personal.

Por otro lado, la valoración económica de estos servicios estima el hipotético valor económico del acceso a los centros de visitantes (precio hipotético de entrada). Este se basa en la pregunta sobre la disponibilidad a pagar una cantidad concreta, una vez realizada la visita. La disposición a pagar por la entrada al centro de visitantes se ha determinado según el método de Krinsky y Robb (Krinsky & Robb, 1990). Para calcular la disponibilidad media a pagar por la entrada se utilizó una regresión paramétrica logit utilizando las respuestas de sí o no a varios precios (1, 2, 5 y 12 euros).

Lugares objeto de estudio: los espacios protegidos en Andalucía como laboratorio en el diseño de herramientas para la toma de decisiones

Andalucía cuenta con una diversa tipología de figuras que definen diferentes grados y tipos de protección de los espacios con valores ambientales en su territorio. Esto es importante cuando se pretende trabajar en la interfaz ciencia-gestión, dado que las unidades administrativas y de gestión ambiental que concurren en la toma de decisiones son diferentes en cada caso:

- Espacios naturales protegidos, donde la gestión depende de manera íntegra de la Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible, que opera directamente en territorio o a través de su empresa pública AMAYA, que ostenta la encomienda de gestión en algunos de los ámbitos.

- Parques periurbanos y reservas naturales concertadas, dónde la Consejería participa en los temas ambientales.

- Espacios naturales de Doñana y Sierra Nevada, que dada su especial régimen de protección y al hecho de contar con la figura de parque nacional, son gestionados íntegramente por sus propias oficinas técnicas.

Andalucía cuenta en su haber con uno de los patrimonios naturales más importante de Europa. Se trata de la comunidad autónoma que más superficie protegida posee en España (casi tres millones de hectáreas), con una Red de Espacios Naturales Protegidos de Andalucía (RENPA) que está constituida por 311 espacios naturales protegidos.

En Andalucía, en función de los valores ambientales, la compatibilidad con los usos humanos, los objetivos de gestión, y la normativa que los define, se distinguen las siguientes figuras de protección:

- Parques Nacionales, con un total de tres espacios en la actualidad, *son espacios naturales poco transformados por la explotación y actividad humanas que han sido declarados de interés general del Estado. Por la belleza de sus paisajes, la representatividad de sus ecosistemas y la singularidad de su flora, fauna, geología y formaciones geomorfológicas, poseen unos valores ecológicos, estéticos, culturales, educativos y científicos destacados, cuya conservación merece una atención preferente* (La Ley 30/2014, de 3 de diciembre).

- Parques Naturales, con un total de veinticuatro espacios en la actualidad, *son áreas naturales, poco transformadas por la explotación u ocupación humana que, en razón de la belleza de sus paisajes, la representatividad de sus ecosistemas o la singularidad de su flora, de su fauna o de sus formaciones geomorfológicas, poseen unos valores ecológicos, estéticos, educativos y científicos cuya conservación merece una atención preferente* (Ley 2/1989, de 18 de julio, por la que se aprueba el Inventario de Espacios Naturales Protegidos de Andalucía).

- Reservas Naturales, con un total de veintiocho espacios en la actualidad, *son espacios protegidos creados para la preservación de ecosistemas, comunidades o elementos biológicos que, por su rareza, fragilidad, importancia o singularidad, merecen una valoración especial* (Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad).

- Parajes Naturales, con un total de treinta y dos espacios actualmente, se trata de lugares excepcionales valores naturales y componentes de muy destacado rango natural, dignos de una protección especial y a los que no son aplicables, por defecto o por exceso, ninguno de los regímenes previstos en la legislación básica estatal (Ley 2/1989, de 18 de julio, por la que se aprueba el Inventario de Espacios Naturales Protegidos de Andalucía).

- Los dos Paisajes Protegidos que hay en territorio andaluz son aquellos lugares concretos del medio natural que, por sus valores

estéticos y culturales, son merecedores de una protección especial (Ley 2/1989, de 18 de julio, por la que se aprueba el Inventario de Espacios Naturales Protegidos de Andalucía).

- Monumentos Naturales, con un total de sesenta espacios, *se trata de elementos que ya gozan del reconocimiento y aprecio de la población por los valores naturales singulares que presentan* (Decreto 225/1999, de 9 de noviembre, de regulación y desarrollo de la figura de Monumento Natural de Andalucía).

- Reservas Naturales Concertadas, con un total de cinco en la actualidad, se definen como aquellos *predios que, sin reunir los requisitos objetivos que caracterizan las figuras de Paraje Natural y Parque Periurbano y en la legislación básica estatal, merezcan una singular protección, y que sus propietarios insten de la Administración ambiental la aplicación en los mismos de un régimen de protección concertado* (Ley 2/1989, de 18 de julio, por la que se aprueba el Inventario de Espacios Naturales Protegidos de Andalucía).

- Parques Periurbanos, con un total de veintiún declarados en Andalucía, son *espacios naturales situados en las proximidades de un núcleo urbano, hayan sido o no creados por el hombre, que atienden a las necesidades recreativas de la población* (Ley 2/1989, de 18 de julio, por la que se aprueba el Inventario de Espacios Naturales Protegidos de Andalucía).

El ámbito espacial en el que se desarrollan todas las actividades de investigación está conformado una variedad de espacios protegidos en Andalucía. El primer capítulo aborda la evaluación del efecto de la declaración y la posterior gestión de espacios naturales protegidos en la sociedad a través de un estudio en los veintidós parques naturales y los dos parques nacionales declarados hasta la fecha del estudio. El capítulo segundo se centró en la evaluación de los servicios ecosistémicos culturales y la caracterización de los visitantes de dos

parques nacionales, interesados en participar en el estudio. Los estudios de los capítulos cuarto y quinto se llevaron una selección de parques naturales, incluyendo además reservas naturales o parques periurbanos para incluir una variedad significativa de los centros de visitantes, que eran el objeto de la evaluación en su papel de co-creación de servicios ecosistémicos recreativos.

Chapter 1

Protected areas as elicitors of human well-being in a developed region: a new synthetic (socioeconomic) approach.

Bonet-García FJ, Pérez-Luque AJ, Moreno-Llorca R, Pérez-Pérez R, Puerta-Piñero C, Zamora R. 2015.

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Abstract

The socioeconomic impact of protected areas, crucial to conservation, has been investigated mainly in low-income, highly biodiverse, contexts. However, studies are needed on the impact of protected areas in high-income places managed for millennia. This work evidences spatial relationships of protected areas and human well-being changes in a highly biodiverse area of southern Spain. We calculated well-being using a synthetic indicator (called the P_2 distance) that integrates information from 22 socioeconomic variables using an iterative procedure to weight the input variables. We used 22 variables to describe well-being according to the categories proposed by the Millennium Ecosystem Assessment. The results reveal significant increases in well-being in Andalusian municipalities between 1989 (when these protected areas were designated) and 2009. This increase was significantly higher in municipalities within protected areas. We also found that a protected municipality increases in well-being irrespective of the size of the protected area encompassing it or the areal percentage covered by the protected area. These results strongly evidence a spatial correspondence between protected areas and improvement of the well-being of local municipalities in areas with long histories of human management.

Keywords

Natural Park, National Park, Protected Areas, welfare, Spain, Mediterranean region

1. Introduction

Can protected areas improve the well-being of local inhabitants? Or, do protected areas limit local economic development? This question is inherently related to the concept of protected area: sites where certain human activities are limited in order to maintain the ecological integrity of the site. Currently, the socioeconomic effect of protected areas is a crucial topic in the context of nature conservation (Adams et al., 2004; Dudley et al., 2014; Roe et al., 2013). This has become one of the key issues influencing the social acceptance of protected areas (Dudley et al., 2014) worldwide. In the last 20-30 years, scientists have created a compelling set of case studies on the socioeconomic impact of protected areas, providing evidence for both the advantages and disadvantages of such protection (Coad et al., 2008; Upton et al., 2008).

It is not easy to establish a general rule to explain the impact of protected areas on socioeconomic features of local human settlements (and buffer areas surrounding protected areas), partly because of the multifaceted local impact that can be exerted under any circumstance (Mackenzie, 2012). However, it is widely accepted that biodiversity loss and well-being are linked problems and that conservation and human well-being should be considered together (Adams et al., 2004). The relationships between protected areas and socioeconomic features are so intricate that they are difficult to describe thoroughly. Like some other social and scientific issues, they can be considered “wicked” problems (Webber, 1973). The complexity of assessing the impact of protected areas on well-being can be exemplified with the concept of confounding variables: effects that are contemporaneous with the protection and could also have an effect on well-being (masking the effect of protection) (Ferraro and Hanauer, 2014; Ferraro and Pattanayak, 2006). Thus it is not easy to distinguish between the effects provoked by protection on well-being from others provoked by different social or biophysical variables. For example, is the observed change in well-being provoked by protection or by the remoteness of the area?

The existence of these confounding factors make it difficult to pinpoint the real cause-effect relationships (Andam et al., 2010). This problem is also common when assessing the effectiveness of parks as tools to protect biodiversity (Naughton-Treves et al., 2005; Porter-Bolland et al., 2012). It is possible to minimize the problem of confounding variables using several approaches (Ferraro and Pattanayak, 2006): A) baseline characteristics can be used to compare between communities living in protected areas and others with similar features not affected by protected areas. Thus it is possible to control the initial conditions that could affect well-being (Andam et al., 2010; Ferraro and Pattanayak, 2006). B) Covariate factors that could influence well-being (Ferraro and Hanauer, 2010). C) Control groups. A set of communities or areas that are not protected but are similar to the protected ones (Kleijn and Sutherland, 2003). The results provided by studies that do not minimize the effect of confounding factors should be considered as correlations instead of cause-effect relationships.

The most relevant socioeconomic costs of protected areas are related to displacement (forced evacuation of local communities from their land due to the creation of a protected area in the surroundings) (Coad et al., 2008; Geisler and De Sousa, 2001; West et al., 2006), which provokes economic impoverishment. However, some displacement processes have improved well-being in local communities (Karanth, 2007). Changes in land tenure can also be considered an important cost (Bedunah and Schmidt, 2004). On the other hand, protected areas can provide significant benefits to local communities. The benefits of nature conservation are evident at a global scale (Balmford et al., 2002): Well-conserved ecosystems can offer more ecosystem services (Cardinale et al., 2006; Costanza et al., 2007) in addition to promoting tourism at the local scale (Ezebilo and Mattsson, 2010; Sims, 2010). This improvement in the capacity of ecosystems to provide services could be transferred to local communities that depend upon protected-area management.

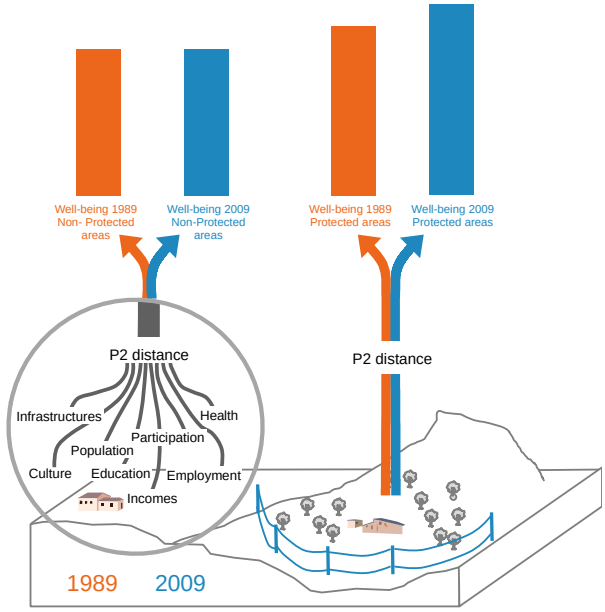

Fig. 1. Well-being is quantified using an aggregated index (P_2 distance) that considers both economic and social indicators. We compared the well-being index among protected and unprotected municipalities over a 20-year time span. The proposed hypothesis states that the well-being increased in Andalusia from 1989 to 2009, but this growth was higher in municipalities affected by a protected area.

Here, we present a diachronic analysis (1989 and 2009) where the main objective is to describe the relationship of protected areas with respect to well-being (measured as an aggregate of different indicators) in a high-income, highly populated, and biodiverse Mediterranean region of southern Spain. We have compared the well-being of municipalities in 1989 (when the protected areas were declared) and 2009. This diachronic analysis follows the hypothesis that well-being depends on natural-resource conservation (Adams et al., 2004). Specifically, we investigated three questions: A) Did well-being significantly change in the municipalities between 1989 and 2009? B) Are the observed changes in well-being related to the presence of protected areas? And C) Is the well-being ratio from 1989 to 2009 related to the area of municipalities and protected areas? Fig. 1 shows both our conceptual model and the proposed hypothesis.

This study is novel for several reasons: A) Most studies analysing the relationship between protected areas and well-being focus on areas where the human impact is recent and the economy is still in a developing phase (Canavire-Bacarreza and Hanauer, 2013), while there is a lack of case studies showing the impact of protected areas in places managed by humans for millennia (e.g. the Mediterranean basin). By contrast, this work presents evidence of differential changes in well-being in a high-income area between protected and non-protected areas. B) Our work has a clearly defined baseline to measure pre- and post-treatment well-being outcomes. The first date of our analysis (1989) is the year when the protected areas were declared in Andalusia. Thus, our dataset is robust enough to support the results found. This baseline is used to partially overcome the problems provoked by confounding factors. C) Most of the studies similar to ours use the GDP (Gross Domestic Product) as a surrogate for well-being. This commonly used indicator is useful to measure only one aspect of the economy (market economic activity). To assess well-being changes, we used a composite indicator called the P_2 distance index, which is a synthetic indicator that combines and weighs a set of simple indicators that help characterize well-being (Somarriba and Pena, 2009; Zarzosa and Somarriba, 2012)

2. Study area

To assess the relationships of protected areas and human well-being, we selected Andalusia as the study area. This Spanish region, located in the south of the Iberian Peninsula, covers 87 597 Km^2 with 8.5 million inhabitants. Andalusia is a major biodiversity hotspot in the Mediterranean region (Estrada et al., 2011; López-López et al., 2011; Moreno Saiz, 2003). The floristic richness of vascular plants in Andalusia has been estimated as c. 4000 species, 436 of which are considered endemic. This region hosts 304 indigenous terrestrial vertebrate species (16 amphibians, 27 reptiles, 56 mammals, and 205 breeding birds; (Estrada et al., 2011)). More than 859 plant taxa and 161 vertebrates are considered endangered species or species under special protection. Also, there are 96 species of regional interest (50% of the species of regional interest in Spain) and 76 Natura 2000 habitats.

A Network of Protected Areas was created in 1989 to protect this diversity. There are 165 protected areas that occupy more than 20% of the region. In this study, we focus on Natural and National Parks (Fig 2) as the protected area types that provide the largest area to the network. There are 24 Natural Parks and 2 National Parks that cover almost 18% of the region (155650 Has). All these parks but one (4996 Has) have also been designated as Special Areas of Conservation (SAC) by the European Natura 2000 Network.

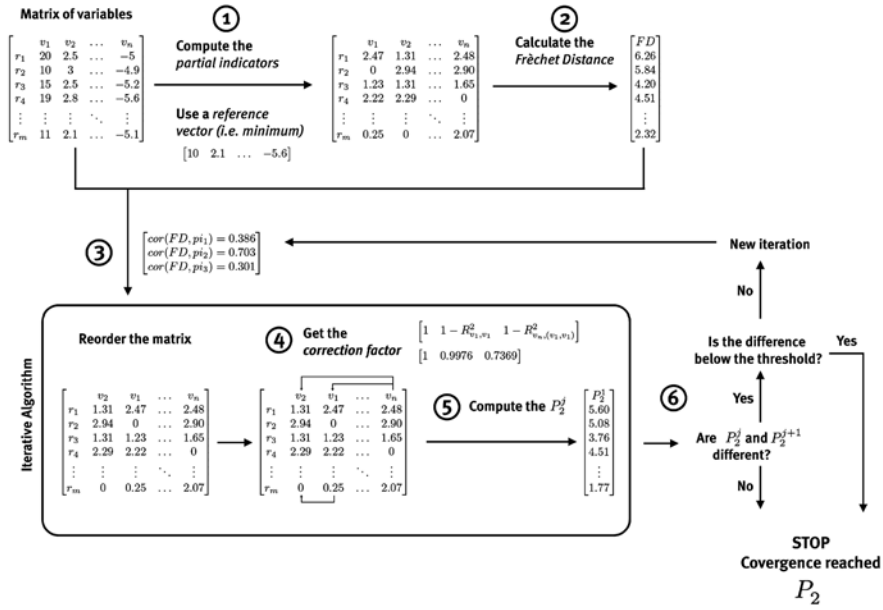

Fig. 2. Schematic representation of P_2 distance computation. 1) The partial indicators are computed from initial matrix of variables according to Equation 1 and using reference vector. Then de Frèchet Distance (FD) is computed (2). The next step is to determine the order of entrance of the variables to compute according to the correlation of partial indicators and FD (3). Once the matrix is reordered, the correction factors of each variable are determined (4) and the first P_2 distance (P_2^1) is computed (5), applying Eq. 3. Finally the difference between P_2^j and P_2^{j+1} is evaluated (in an initial iteration the FD and the P_2^1 are compared). If the difference is zero, the iterative algorithm stops (6); otherwise the matrix is reordered according to the correlation of partial indicators, and the last P_2^j obtained and a new P_2 is computed. For more details see text.

3. Material and Methods

3.1. Datasets

We have employed three main datasets in this study: location of parks, location of municipalities, and well-being of municipalities.

3.1.1. Location of Natural and National Parks.

Natural Parks can be considered to be *Protected Landscape/seascape* (code V) according to IUCN classification of protected areas (Chape et al., 2008). Areas belonging to this category have an explicit natural conservation plan, but also accommodate a range of profit-making activities. Some Andalusian Natural Parks contain areas that belong to the IUCN category IV: *Habitat/species management area*. These areas are devoted specifically to habitat and species conservation. The two existing National Parks fit well with the IUCN category II: *National Parks*: Areas specifically designated to protect ecosystem functioning but allowing human visits and a supporting infrastructure.

Most of the Natural Parks (17) were officially designated as protected areas in 1989. Some others (5) were designated between 1985 and 1988. Finally, one Park was designated in 1999 and another one in 2003. On the other hand, the two existing National Parks have been included in this work because they are surrounded by Natural Parks designated in 1989 (acting as a buffer zone *sensu* UNESCO biosphere reserves). All these protected areas include the most important natural areas of Andalusia in terms of biodiversity, geodiversity, and ecosystem conservation.

3.1.2. Municipalities

Municipalities in Spain are administrative units governing a city or town. There are 771 municipalities in Andalusia with areas ranging from 1.95 Km^2 to 1250 Km^2. We have excluded some municipalities that underwent changes in their borders during the time span used in this work (1989-2009). Thus, our dataset contains 749 municipalities (97.14%) that cover 98.63% of the total area of Andalusia. The Institute of Statistics and Cartography of Andalusia provided the spatial borders of the municipalities.

3.1.3. Dependent variable (well-being in municipalities)

Human well-being is an abstract and dynamic concept related to satisfaction with life. Thus, this concept contains psychological and subjective elements that are difficult to quantify. Surrogates of well-being such as GDP have been traditionally used (Costanza et al., 2014) in order to avoid the complexity brought about by the aforementioned subjectivity. However, GDP was not designed to measure social or economic well-being (Costanza et al., 2014; Kubiszewski et al., 2013). In recent years, some social scientists have developed a set of alternative measures of well-being that relies on weighted composite indicators (Van de Kerk and Manuel, 2008; Vemuri and Costanza, 2006). These techniques integrate both subjective and objective indicators to assess human well-being. They also take into account human capabilities (Distaso, 2007; Nussbaum and Sen, 1993) as well as needs (Clarke, 2005; Costanza et al., 2007; Doyal and Gough, 1991; Streeten, 1981). We have calculated the well-being of Andalusian municipalities using a set of 22 indicators grouped into 8 thematic categories (population, health, employment, economy and income, infrastructure and services, education, culture and leisure, social participation; see Table 1 for details). This hierarchy between indicators and dimensions helps to provide a comprehensive picture of well-being (Costanza et al., 2014, 2007).

One of the key steps of these weighted composite measures is the selection both of indicators and dimensions (Somarriba and Pena, 2009). Authors select different dimensions (thematic areas) depending on data availability, specific socioeconomic features of the study area, purpose, etc.. Likewise, the dimensions and single variables need to be adapted to both the spatio-temporal scale and the economy of the study area (e.g. some indicators used to compare well-being among countries cannot be used at a municipal scale: number of hospitals/10,000 population). We selected a set of dimensions and indicators corresponding to four components of human well-being (Table 1) identified in the Millennium Ecosystem Assessment (MEA). We are missing only the MEA's category called "security". We found no indicator to include in this category. However, we are aware that this mapping between indicators and categories is subjective and can be discussed. In any case, the P_2 computation is not affected by the categories used to group the indicators. We computed the well-being index by using the P_2 distance index, a synthetic index that combines all of these indicators into a single value. The P_2 distance (Somarriba and Pena, 2009) is a synthetic indicator created to calculate well-being and other related social indicators (e.g. to measure poverty (Zarzosa Espina, 2009) and development (Cuenca García et al., 2010; Martín et al., 2015, 2013). This approach has also been used to build synthetic indicators in other disciplines such as environmental indexes (Escobar, 2006; Montero et al., 2010), mother and child health in developing countries (Ray, 2014) or tourism (Blancas et al., 2011; Blancas-Peral et al., 2012; Lozano-Oyola et al., 2012)

The *P_2 distance* is a quantitative distance indicator capable of combining several variables expressed in different units (Montero et al., 2010). It allows comparisons between entities (both temporal and spatial) and is considered to be an exhaustive synthetic indicator because it is not based on a reduction of information. It considers all the valuable information contained in the variables used to build it. This property allows the inclusion of a great number of variables, since all redundant variance is removed by the process itself, as is the multicollinearity (Montero et al., 2010).

MEA's DIMENSIONS	INDICATORS	DESCRIPTION
Basic material for a good life	Employed population	[number of employed people ≥ 16years old/ population from 15 to 64 years old]*100
	Unemployed population	[number of unemployed/ population from 15 to 64 years old]*100
	Business activity	[number of business activities / total population]*1000
	Personal Income	[total income of people / total population]
	Buses	[number of buses/ total population]*1000
	Lorries	[number of lorries / total population]*1000
	Vans	[number of vans/ total population]*1000
	Cars	[number of cars / total population]*100
	Phone lines	[number of phone lines / total population]*100
	Schools	[number of public primary schools / total population]*1000
	Elementary students	[number of elementary students in public schools / total population] *1000
	Elementary teachers	[number of elementary teachers in public schools/total population]*1000
	Public libraries	[number of libraries in public schools/total population]*1000
Freedom for choice and action	International migration	[Number of migrations from the municipality to any other Spanish destination / total population]*100
	Interior migration	[Number of migrations from any other Spanish origin to an Andalusian municipality/ total population]*1000
	Voter turnout	[number of voters / total population]*1000
Good social relations	Hotels	[number of hotels / total population]*1000
	Restaurants	[number of restaurants / total population]*1000
Health	Births	[Live-born infants / total population]*1000
	Population growth	[Difference between births and deaths /total population]*1000
	Aging index	[number of people≥ 65 years old/number of people<15 years old] *100
	Healthcare centres	[Number of primary health centres / total population]*1000

Table 1. Indicators used to compute the well-being index. The first column shows the "Millennium Ecosystem Assessment" categories to which each indicator belongs. This set of indicators was selected to assess the well-being in a developed region. We have also considered only those indicators that are applicable both in 1989 and 2009 (i.e. density of cell phones is not a good indicator). All indicators were taken from the Institute of Statistics and Cartography of Andalusia.

The P_2 *distance* satisfies the properties of existence, determination, monotony, uniqueness quantification, invariance, homogeneity, transitivity, exhaustiveness, additivity, invariance compared to the base reference, conformity, and neutrality (Zarzosa and Somarriba, 2012).

To calculate the P_2 distance, we started with a matrix X of order (m,n) in which m is the number of spatial units (countries, municipalities, etc.) and n is the number of variables. Each element of this matrix, x_{ri} , is the value of the variable i in the spatial entity r. The P_2 distance indicator calculates the distance of each spatial entity with regard to a theoretical spatial entity of reference. Initially, a distance matrix D is calculated as:

$$d_{ri} = |x_{ri} - x_{*i}| \qquad \textbf{(Eq. 1)}$$

where, x_{*i} is the r-th element of the reference base vector $X_* = (x_{*1}, x_{*2},..., x_{*n})$. For each variable a reference value must be defined to compare different spatial entities.

The minimum value is often used in sociological studies (Rodríguez Martín, 2011; Somarriba and Pena, 2009; Zarzosa and Somarriba, 2012); but any other vector (i.e. maximum, average, a user-defined vector, etc.) that reflects the ideal condition with which to compare the spatial entities can also be used. We used the minimum value and we also computed the absolute value of the difference in order to avoid treating positive differences and negative differences in the same way (Somarriba Arechavala et al., 2014).

For each variable, dri , represents the distance between the r-th entity and its reference value. To avoid heterogeneity in the measuring units of the variables, we calculated a partial indicator. This partial indicator is calculated in the same way as the dri value, but divided by the standard deviation of each variable $(\frac{d_{ri}}{\sigma_i})$. With these partial indicators, we calculated the Frèchet Distance (FD) as

$$FD(r) = \sum_{i=1}^{n} \frac{d_{ri}}{\sigma_i} = \sum_{i=1}^{n} \frac{|x_{ri} - x_{*i}|}{\sigma_i}; \qquad r = 1,2,\dots,m \qquad \textbf{(Eq. 2)}$$

This is the maximum value that the P_2 index can reach for each spatial entity. The FD concept of distance is valid only in a theoretical situation of uncorrelated indicators. However, it is common to find direct relationships between the partial indicators, implying that FD includes duplicate information. For this problem, a correction is introduced into FD, resulting in the P_2 distance, which is computed as:

$$P_2(r) = \sum_{i=1}^{n} \{(\frac{d_{ri}}{\sigma_i})\,(1 - R^2_{i,i-1,i-2,\dots,1})\}; \qquad r = 1,2,\dots,m \qquad \textbf{(Eq. 3)}$$

where $R^2_{i,i-1,i-2,\dots,1}$ is the determination coefficient of the regression of each partial indicator on the others *(i—1, i—2,...,1)*. This coefficient measures the part of the variance of each variable explained by the linear regression estimated using the above variables. As a result, the factor $1-R^2_{i,i-1,i-2,\dots,1}$ prevents redundancy by removing from the partial indicators the information already contained in the aforementioned indicators. This factor, called the *correction factor* (Pena, 1977), subtracts the proportion of variation of the observed values that is due to linear dependency. Note that if all the partial indicators are uncorrelated, i.e. $R^2 = 0$, then the P_2 distance is equal to FD. The order of entrance of the partial indicators is a critical issue within this method. We needed to find a procedure to decide which partial indicator comes first in contributing its variance to the global index (Montero et al., 2010). We used an iterative algorithm to resolve this issue and to determine the weights of each variable.

In an initial step, given that FD (see Eq. 2) contains the information of all partial indicators, the variable most closely correlated to FD is the variable that contributes the most in variance to the overall index, and consequently the first variable to enter. Thus, the ranking of correlation of partial indicators with FD determines the order of entrance of variables in the first iteration. With this order, the first P_2 distance is calculated according to Eq. 3. The result is called P_2^1.

In the second step, the correlation of each variable with this P_2^1 index is calculated, and the resulting ranking is used to determine once more the order of entrance when re-computing the P_2 distance, resulting in a second index called P_2^2.

This process is repeated iteratively until convergence is reached: when the difference between two contiguous P_2^j is zero. The final P_2 is then the first index P_2^j that has no differences with respect to the following index P_2^{j+1}.

We calculated the well-being index for the municipalities in 1989 and 2009 following the above-described approach. Fig. 2 summarizes the procedure used to compute P_2 index.

3.2. Statistical Analysis

All analyses were performed using R software (R Core Team 2013), including several packages: boot (Canty and Ripley, 2014), Kendall (McLeod, 2011), p2distance (Pérez-Luque et al., 2012), party (Hothorn et al., 2006), spatstat (Baddeley and Turner, 2005).

The following paragraphs describe the statistical analyses performed in order to answer three relevant questions:

3.2.1. Did well-being in the municipalities significantly change between 1989 and 2009?

The non-parametric paired Wilcoxon signed-rank test was used to compare well-being between 1989 and 2009 because the data did not meet the normality and homoscedasticity assumptions. To determine whether the overall difference significantly differed from zero, we computed differences by drawing 9999 bootstrap replicates from the data. A Monte-Carlo *p-value* with the correction proposed by Davison

and Hinkley (1997) was computed. We generated 99% confidence intervals for mean effect sizes by bootstrapping (n = 9999 permutations). We also calculated Hedge's effect size (g) for the difference.

For each municipality, we computed a well-being ratio (WR) as the ratio between the well-being in 2009 and well-being in 1989

$$WR = \frac{W_{2009}}{W_{1989}} \qquad \textbf{(Eq. 4)}$$

A value of WR greater than 1 indicates well-being improvement whereas a value less than 1 indicates worsening over the time period considered.

3.2.2. Are the observed changes in well-being related to the presence of protected areas in Andalusia?

We performed a non-parametric Wilcoxon signed-rank to compare the well-being ratio (Eq. 4) between municipalities inside and outside the protected areas. We also computed differences using bootstrap (n = 9999 simulations) to test whether the overall difference significantly differed from zero. Then, Monte-Carlo *p-value* with the correction proposed by Davison and Hinkley (1997) and confidence intervals (at 99% level) for the mean difference were computed. Finally we also calculated Hedge's effect size (g) for the difference between protected and non-protected municipalities.

We also conducted a moving-average window analysis to assess the spatial distribution of well-being and Natural Parks. For each municipality, we calculated the average well-being ratio of its neighbours considering a changing radius from 2 to 30 Km (2, 3, 4, 5, 8, 10, 12, 15, 20, and 30 Km). Then we calculated the average well-being ratio for all protected and non-protected municipalities at any single window radius. We finally computed Kendall's rank correlation for the two series (protected and non-protected municipalities).

Is the well-being ratio between 1989 and 2009 related to the surface area of the municipalities and protected areas?

The relationship between the average well-being of each protected area and its surface area was evaluated using Pearson's correlation coefficient. We also created a classification tree to explore the relationship between the well-being of all the protected municipalities and the percentage of their area affected by Natural Parks. This methodological approach sequentially partitions the dataset based on predictor variables into the most pure class memberships (Verbyla, 1987).

4. Results

4.1. Did well-being significantly change in the municipalities between 1989 and 2009?

The well-being index was significantly higher in 2009 than in 1989 (well-being index 1989 = 51.04 ± 0.13, n = 749; well-being index 2009 = 57.41 ± 0.16, n = 749; paired Wilcoxon signed-rank test Z= 3397, p-$value$< 0.0001). The mean difference significantly differed from zero (p-$value$ = 0.0001, IC 99%= 5.89 – 6.84) and the effect size was very large (*Hedges's g* = 1.622) (Fig. 4a). The well-being ratio ranged from 0.6817 to 1.5728. There were only 32 municipalities (4.27 %) with a well-being ratio below 1 (Fig. 3c). The observed increase in well-being followed a well-defined spatial pattern within Andalusia (Fig. 3c). Municipalities from mountain areas (NW, NE, SE) showed well-being ratios higher than 1, signifying a strong improvement in well-being. Municipalities located in the central part of Andalusia (Guadalquivir Valley) showed a smaller increment in well-being. Finally, some municipalities located in the Mediterranean Coast decreased in well-being.

4.2. Are the observed changes in well-being related to the presence of protected areas in Andalusia?

The distribution of the well-being ratio between 1989 and 2009 spatially matches the distribution of the parks (Fig. 3b). We found significant differences in the well-being ratio between protected (PA) and non-protected (nPA) municipalities (PA = 1.144 ± 0.007, n = 225; nPA = 1.121 ± 0.003, n= 524; Wilcoxon signed-rank test Z= 66317, p-value = 0.0066) (Fig. 4b). The mean difference significantly differed from zero (p-value = 0.001, IC 99%= 0.0043– 0.0428) and the effect size was small (Hedges's g = 0.259). The well-being index in 1989 was similar both in protected and non-protected municipalities, and both increased their well-being in 2009. However, the increment was higher in protected municipalities than in non-protected ones (Table 1, Fig. 4b).

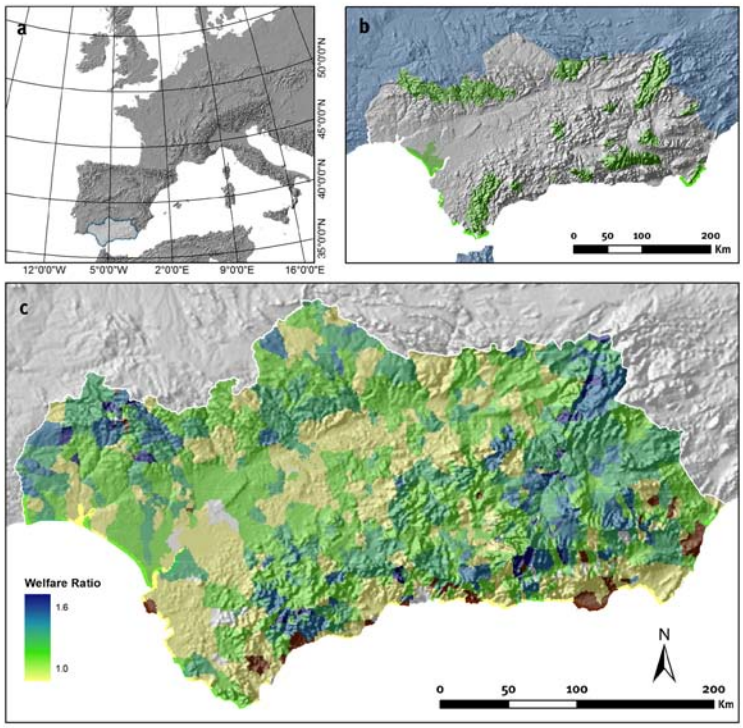

Fig. 3. (a) Location of study area. (b) Distribution of parks (green) in the study area (c). Well-being ratio for Andalusian municipalities. Municipalities with values of Well-being ratio below 1 are shown in red.

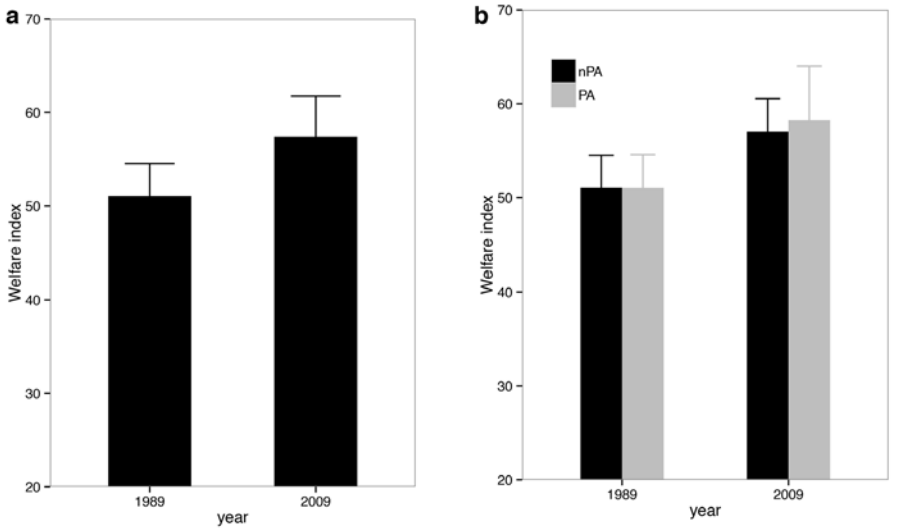

Fig. 4. a) Well-being of Andalusian municipalities in 1989 and 2009. b) Comparison of well-being index in 1989 and 2009 between protected and unprotected municipalities of Andalusia. Showing means and standard deviation.

The moving-average windows analysis helped us to describe the spatial relationship between well-being ratio and the distribution of Natural Parks in Andalusia. The average well-being ratio calculated by each window radius for protected municipalities showed a non-significant negative correlation (*tau* = -0.289, p-value =0.2912, n=10). This result is consistent with the expected one: The higher one is the window radius, the higher the likelihood to include in the window non-protected municipalities (which would decrease the average WR). On the other hand, the average well-being ratio calculated by each window radius for non-protected municipalities shows a non-significant positive correlation (*tau* = 0.333, p-value =0.22164). This is also consistent with the expected one: The higher the radius, the higher the likelihood of including protected municipalities in the window (which would increase the average WR).

4.3. Is the well-being ratio between 1989 and 2009 related to the area of municipalities and parks?

We also explored the relationships between well-being ratio and the area of both the municipalities and the parks. No significant relationship was detected between the park area and the well-being ratio of municipalities within each park (Pearson's correlation coefficient: 0.102; p-value=0.62) (Fig. 5a). On the other hand, considering only protected municipalities, we found the percentage of each municipality covered by a park not to be significantly related to its well-being ratio unless this percentage was close to 100% (Fig. 5b).

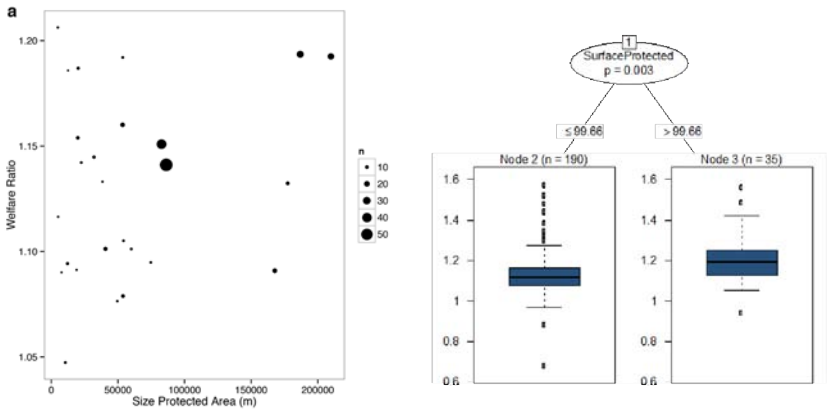

Fig. 5. Spatial relationships between the well-being ratio and area surface of the protected municipalities. A) Relationship between the size of parks (Has) (x axis) and their average well-being ratio (y axis). The size of the circle shows the number of municipalities per park. B) Classification scheme to discriminate the relationship between the area affected by parks in municipalities and the well-being ratio.

5. Discussion

Most of the studies assessing the relationships between human well-being (or poverty) and protected areas focus on developing countries (Ezebilo and Mattsson, 2010; Hübner et al., 2014; Katikiro et al., 2015). We addressed this issue in a high-income European region

using a diachronic approach. We assessed the changes in well-being in Andalusia (southern Spain) between 1989 and 2009, exploring the importance of parks in the observed changes. Our results evidence a correlation between the observed changes in well-being and the distribution of parks.-

We found a significant increase in well-being in Andalusia from 1989 to 2009. This result matches the evolution of some indicators that contribute to well-being: During this period, the Andalusian per capita GDP grew by nearly 45% (*Informe económico de Andalucía: 2010.*, 2010, "La transformación de Andalucía 1990-2010," 2010). This economic growth is linked to a notable improvement in roads and transportation infrastructures (Jaén García and Piedra Muñoz, 2010). Education also improved in the last few decades in Andalusia. The illiteracy rate shrank from 15% in 1980 to 4% in 2011. Health indicators are also concordant with the observed increase in well-being: The amount of public healthcare centres has also increased from 233 in 1980 to 1514 in 2009.

Our results also demonstrate that the distribution of the well-being ratio spatially matches the distribution of parks in Andalusia. Municipalities influenced by a park have a higher well-being ratio than do those in unprotected settings. Well-being increased during the study period in most Andalusian municipalities, but the protected ones registered significantly higher growth.

The observed increase in well-being follows a well-defined spatial pattern within Andalusia. Municipalities from Sierra Morena (NW) and Baetic mountains (NE, SE) show a well-being ratio higher than 1, meaning a strong improvement in well-being. Municipalities located in the Guadalquivir Valley (central area) show a slighter increment in well-being. Finally, some municipalities located on the Mediterranean Coast have declined in well-being. Notably, the spatial distribution of well-being ratio follows a counterintuitive pattern: natural and traditionally

depressed areas display a higher well-being ratios than do economically developed and altered areas. This result could be explained by a differential impact of the actions carried out to promote well-being in Andalusia under a spatial perspective: parks seem to have behaved as attractors of policies promoting well-being .

However, we found no significant relationship between the well-being of municipalities and the area of their surrounding park. Nor did we find a significant relationship between the protected percentage of municipalities and their well-being ratio. These results suggest that the proposed positive effect of nature conservancy on well-being could follow a binary pattern: protected municipalities increased in well-being irrespective of a) the size of the park surrounding it and b) the percentage of its area affected by the park. This result contrasts with the findings of some studies in developing countries, where the percentage of protected area per municipality determined the amount of poverty reduction (Canavire-Bacarreza and Hanauer, 2013). This behaviour could be explained by the differential impacts that some factors can have on well-being. Thus, some managerial actions conducted by government to improve well-being could have a spatially homogeneous impact on local communities affected by parks (e.g. compensation for the restrictions imposed by protection, improvements in health care, etc.). These actions would provoke a direct relationship between the area conserved and the increase in well-being (the higher the area conserved, the higher the improvement in well-being). On the other hand, some other variables could have a spatially heterogeneous impact on local communities. Tourism could be a good example of this pattern. Only some areas of a park act as touristic foci to attract visitors. This would provoke a decline in marginal gains as the area conserved expands.

The regional government of Andalusia has been trying to promote well-being in municipalities in contact with protected areas since 1989. The so-called “socioeconomic influence area of the parks” have received almost 10% (10,000 million €) of the funds provided by European Union

since 1989. This amount of money has been invested in promoting sustainable farming, infrastructures, and nature-based tourism in protected areas via European Regional Development Fund (ERDF) and European Social Fund (ESF). In addition, local communities have also benefited from forest management and habitat management (wildfire prevention, forest restoration, etc.) as they have been contracted by the government to execute those tasks. On the other hand, people living within parks have also benefited from the general improvement in health care, education, and infrastructures. Thus, they are living in a well-conserved area surrounded by modern services. This set of reasons could explain the observed correlation between protected areas and well-being increase and can be considered as managerial actions carried out by the government to directly benefit people living in protected areas (Coad et al., 2008). Regarding this topic, it might be useful to assess how these managerial activities can impact the well-being of different groups of local communities in different ways (see Mascia et al., 2010 for an example). This type of analysis could help to describe with detail the mechanism by which the above-mentioned managerial actions foster well-being. For example, which professional or social groups are more benefited (or disadvantaged) by the managerial actions intended to promote well-being? As the datasets used in this study refer to municipalities as a whole, it was not possible to address these kinds of topics.

In conclusion, our novel analytical approach provides strong evidence of a spatial correspondence between nature conservancy and well-being in a developed region (Andalusia, a region as big as some European countries, inhabited by humans for millennia, and a major biodiversity hotspot).

Acknowledgments

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Chapter 2

Evaluating tourist profiles and nature-based experiences in Biosphere Reserves using Flickr: matches and mismatches between online social surveys and photo content analysis

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Abstract

Monitoring visitor dynamics and their nature-based experiences is an important dimension in the conservation management of protected areas. In the current digital age, the content analysis of social media information is being increasingly used in such a context. However, research testing whether social media content analysis provides similar information to that obtained from stated preference methods is lacking. We aimed to identify differences in the classification of tourist profiles and nature-based experiences, both from online social surveys and photo content analysis. Our approach targeted Flickr's social media users visiting two Biosphere Reserves in Southern Europe: Doñana and Sierra Nevada. We manually classified the main content of Flickr photos considering different categories of tourist profiles and nature-based experiences. Concurrently, we distributed online surveys to Flickr users responsible for those photos and gathered their self-stated classification of tourist profiles and experiences. Finally, we compared the classification results from both content analysis and online surveys using multiple congruence metrics and tests. Overall, we found both matches and mismatches between the results from content analysis and online surveys depending on the categories of tourist profiles and their experiences. "Landscape and species" was the only category with consistent matches between content analysis and online surveys for both tourist profiles and nature-based experiences. We suggest that conclusions based on content analysis or online surveys alone can lead to incomplete information. Instead, the adoption of both content analysis and online surveys should provide complementary perspectives for the monitoring of nature's cultural capital.

Keywords

Crowd-sourced photos; Cultural ecosystem services; Doñana; Decision making; Protected areas; Sierra Nevada

1. Introduction

In the current epoch of the Anthropocene, characterised by dynamic human and environmental changes, conservation mechanisms need to integrate a wider social-ecological perspective (Palomo et al. 2014). Biodiversity conservation mechanisms, such as the establishment of protected areas, have been increasingly re-defined to integrate both biophysical and social aspects of ecosystems (Daily et al. 2000). This is because in many regions worldwide, local communities co-exist with protected area and play an important role in the management of ecosystems and their resources (Venter et al. 2014).

The "Biosphere Reserve" status has been created by the UNESCO to deal with the interactions between social and ecological systems in protected areas. The rapid development of a global network of Biosphere Reserves reveals many opportunities to reach conservation goals alongside the sustainable use of natural resources (Van Cuong et al. 2017). Therefore, Biosphere Reserves provide a wide perspective on the territory, focused on the co-existence of nature, human culture and sustainable development.

Ecotourism and other nature-based experiences are an important dimension of Biosphere Reserves (UNESCO 2002), providing recreation revenues, shaping human identity and traditions and supporting nature conservation (Di Minin et al. 2015). Neglecting the role of nature-based experiences can result in losses of e.g. cultural identity and heritage, environmental education, and nature enjoyment (De Groot et al. 2005). Nevertheless, ecotourism may also have opposite effects, promoting human pressure and undesirable impacts on biodiversity (Buckley et al. 2016). Therefore, understanding how people interact with nature is essential to inform conservation policy and management.

Nature-based experiences have been traditional estimated from stated preference methods (e.g. questionnaires), which are often

costly and limited in geographic space (Bragagnolo et al. 2016). With the emergence of digital conservation (Van der Wal and Arts 2015), social media "big data" has been seen as an alternative way to infer on nature-human interactions, such as visitors' monitoring (Tenkanen et al. 2017; Walden-Schreiner et al. 2018) or nature-based recreation (Jepson and Ladle 2015). Analysing photos posted and shared in social media platforms, such as Flickr, has been receiving particular attention (Di Minin et al. 2015; Ladle et al. 2016; Thiagarajah et al. 2015). This is because social media content analysis allows scientists to evaluate and map nature-human interactions, at multiple scales and resolutions and in a cost-effective and forthright manner (Richards and Friess 2015).

Several approaches focused on the content analysis of social media have been developed to assess human activities and people's preferences for nature-based activities (Allendorf and Yang 2013). However, social media photo content analysis can be biased due to many factors, such as sociodemographic characteristics or differences in landscape perception by social media users (Ghermandi and Sinclair 2019). Given that perceptions and sentimental reactions change between different user profiles (Komossa et al. 2018), inferring about which nature elements are being valued in a photo (and by whom) is still a major challenge in content analysis (Heikinheimo et al. 2017).

Considering the increasing scientific interest in social media content analysis, investigating the added-value of social media data in relation to other methods to monitor nature-based activities is needed (Di Minin et al. 2015). However, few studies have explicitly evaluated the usefulness of social media data in this regard (Hausmann et al. 2018; Heikinheimo et al. 2017). Despite similarities in the information obtained from social media and on-the-ground surveys, e.g. in protected areas from South Africa (Hausmann et al. 2018) and in Finland (Heikinheimo et al. 2017), evidence from other social-ecological contexts and assessment methods (e.g. online surveys), which target the same populations are lacking.

Here we aimed to identify differences in the classification of tourist profiles and nature-based experiences, as obtained from online surveys to Flickr users and from our content analysis of the photos posted by those same users. Specifically, our objective was to understand whether the content analysis of those photos would reflect the tourist profiles ("the who") and their nature-based experiences ("the what") as stated by the Flickr users through online questionnaires. To do so, we asked the following questions: (1) What categories of tourist profiles and nature-based experiences are most identified in the content analysis of Flickr´s photos and in the users' replies to online surveys? (2) Do results from content analysis and online surveys generally match in the identification of tourist profiles and nature-based experiences? and, (3) Which types of tourist profiles and nature-based experiences seem to agree the most between in the classifications obtained from content analysis and from online surveys? Our approach is independently tested in two UNESCO Biosphere Reserves from Southern Spain: Doñana and Sierra Nevada.

Figure 1. Location of the test areas at the European and Spanish contexts (a), with detailed overview on Doñana and Sierra Nevada biosphere reserves (b).

2. Methods

2.1. Test areas

Our test areas included two UNESCO Biosphere Reserves in southern Spain: Doñana and Sierra Nevada (Figure 1).

Doñana (2687 km^2) includes one of the largest wetlands in Western Europe (García and Marín, 2005), marshlands (270 km^2), phreatic lagoons, coastal dune ecosystems (25 km-long coastline) and emblematic Mediterranean plant communities (100 km^2). Doñana shows a high bird diversity, being an important overwintering site for water birds. Doñana includes a Ramsar Site, a Natural World Heritage Site and it is a long-term monitoring site in the ALTERNet being integrated in the Natura 2000 network (with both National and Natural Parks). Doñana spreads over the Spanish provinces of Huelva, Seville and Cádiz, including 14 municipalities with more than 163000 inhabitants. Relevant socio-economic activities include agriculture, fishing, cattle raising, timber, beekeeping, nature tourism, and beach recreation (García and Marín, 2005).

Sierra Nevada (1722 km^2) is a mountainous region, with altitude ranging from 860 m to 3482 m.a.s.l. (the highest peak of the summit). Sierra Nevada is among the most important biodiversity hotspots in the Mediterranean region with a total of more than 2,300 taxa of vascular flora, representing 33.2 % of the Spanish flora. The reserve comprises 27 habitats types from the Habitats Directive, with 31 animal and 20 plant species listed in Annex I and II of the Habitats and Birds directives. Besides being a biosphere reserve, Sierra Nevada also includes Special Protection Areas and Sites of Community Importance (Natura 2000 network) as well as National and Natural Parks. Sierra Nevada spreads over Granada and Almería provinces, with 61 municipalities and more than 90 000 inhabitants. The most relevant socio-economic activity is mostly related to tourism (Zamora et al. 2016).

2.2. Analytical framework

Our general approach is illustrated in Figure 2. Firstly, we collected photographic data from the online social media platform Flickr, considering a stratified sampling procedure for each Biosphere Reserve: Doñana (number of photos, n = 11441) and Sierra Nevada (n = 21048; see section "Sampling strategy and data processing"). Secondly, we classified the photos from each biosphere reserve according to the tourist profiles and the prevailing nature-based experience by means of content analysis (see "Content analysis" section). Thirdly, we distributed online surveys to the Flickr users responsible for each photo, in order to gather their stated information on the tourist profile they are and prevailing nature-based experience they carried out in the BR (see "Online surveys" section). Finally, we compared the classification results from the photo content analysis with those from online surveys, using multiple evaluation metrics (see "Data analysis" section).

2.3. Sampling strategy and data processing

We collected publicly available information on the photos published by Flickr users for each biosphere reserve. We used the Application Programming Interface (API) from Flickr, indicating a time window (between the start of Flickr in 2004 and 2017) and a spatial bounding box around the boundaries of each test area. For each photo, we retrieved their date taken, their spatial location (latitude and longitude), the responsible Flickr user, and the corresponding photo gallery and URL. The content of each photo was analysed for a subset of photos, obtained through a stratified sampling strategy. The sampling was established in order to capture the diversity of prevailing nature protection regimes and land uses in both reserves. This resulted in final subsets of 925 photos (from 663 users) in Doñana and 889 photos (from 708 users) in Sierra Nevada. Details on the sampling procedure and strata description can be found in Supplementary Material (see "Sampling strategy" section).

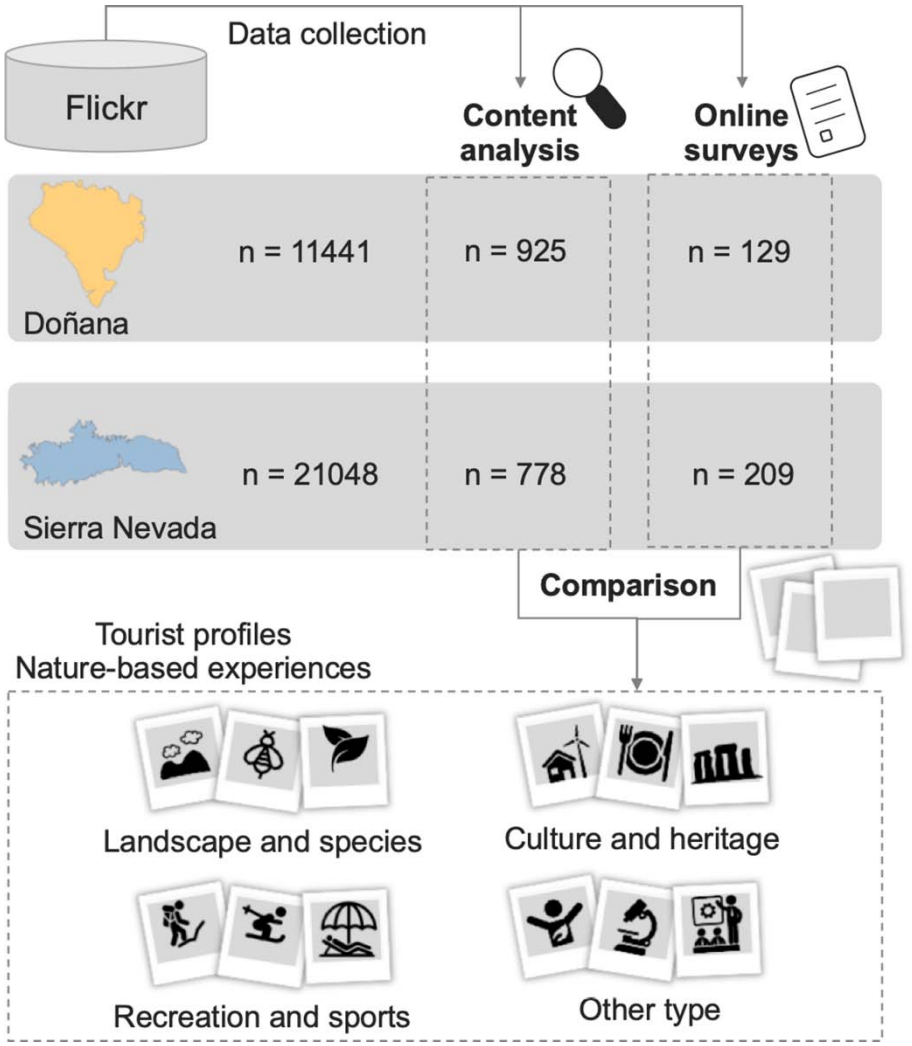

Figure 2. The analytical framework considered to compare the information on tourist profiles and nature-based experiences based on content analysis of Flickr photos and user-stated preferences from online surveys for Doñana and Sierra Nevada.

2.3.1. Content analysis

We performed a content analysis expressed by the manual and visual classification of Flickr photos collected for each Biosphere Reserve. The classification of Flickr photos was based on general categories associated to nature tourism and recreation, following our previous experience (Fernández-Méndez et al. 2019; Vaz et al. 2018) and other related studies (Martínez Pastur et al. 2016; Oteros-Rozas et al. 2018). We used the same categories to classify the photos based on the tourist profile and nature-based experience. Although the classification of nature-based experiences was done considering only the content of each individual photo, tourist profiles were classified considering also the content of the whole photo gallery from the Flickr user. Table S1 (Supplementary Material) shows the description of the categories considered in the content analysis. Unidentifiable photos (e.g. due to poor quality) or photos capturing indoor places or non-natural features (e.g. pamphlets, advertisements) were not considered, resulting in a final dataset of 925 photos for Doñana and 889 for Sierra Nevada. Details on the content analysis and photo classification can be found in Supplementary Material (see "Content analysis" section).

2.3.2. Online surveys

We distributed an online questionnaire to the Flickr users responsible for the same photos considered in the content analysis, in order to get their stated-classification on the tourist profiles and nature-based experiences (please see "Online surveys" section in Supplementary Material). We used Google Forms (https://docs.google.com/forms) to develop the online surveys (in English and Spanish). Questionnaires focused on what the users recalled from their trip/visit to the biosphere reserves, given particular (set of) pictures taken at that given time to explicitly ask the user about: (1) the "who" - which tourist profile he/she would consider to be the most (given the set of options presented in Table S1 in Supplementary Material); and (2) the "what" - which type of

nature-based experience were they being enjoyed by the user while taking the photo (again, considering Table S1's options, in Supplementary Material). Questionnaires were disseminated through Flickr Mail between March and September of 2018 to a total of 1437 users (669 Flickr users in Doñana and 768 users in Sierra Nevada). Dissemination of questionnaires targeted first the users from the most recent pictures; however, due to the low number of feedbacks, questionnaires were sent to the remaining users. The invitations sent to the users included a brief description of the research and a weblink to access the questionnaires. We obtained a total of 338 responses (129 for Doñana and 209 for Sierra Nevada), from which 75% pertained to Flickr photos taken during the last five years, and less than 8% pertained to photos taken during the first five years of the study timeframe (2004-2009). Information from the participants was kept anonymised through the whole study (see Supplementary Material for details).

2.4. Data analysis

The results from the classification of photos obtained from the content analysis and online surveys were evaluated individually for each biosphere reserve. We first conducted a descriptive analysis, based on the relative proportion of photos attributed to each content analysis and online surveys category. In order to compare the congruence between content analysis and online surveys classifications on tourist profiles and nature-based experiences, we used multiple evaluation metrics based on confusion matrices. The overall congruence between both classifications was evaluated by computing the global agreement (%) and accuracy metrics, supported by the Pearson chi-square test for independence and the Cohen's kappa coefficient. We further calculated the Precision, Recall and the F1 scores for each individual category of tourist profiles and nature-based experiences based on the results from content analysis and online surveys. Details are shown in following sections.

2.4.1. Overall congruence between content analysis and online surveys classifications

In order to evaluate the overall congruence between content analysis and online surveys, we used the "global agreement" and "global accuracy" metrics. The global agreement indicates the percentage of photos matching the same categories in both content analysis and online surveys, weighted by the total number of photos under evaluation (eq. 1). The global accuracy between classifications indicates the proportion of photos matching or not the same category, weighted by the total number of photos (eq. 2).

$$\text{Global agreement} = (A / n) * 100 \quad \text{(Eq. 1)}$$

$$\text{Global accuracy} = ((A + D) / n) * 100 \quad \text{(Eq. 2)}$$

In equations 1 and 2: *A* stands for the number of records for which a given category of tourist profiles or nature-based experiences was indicated in both content analysis and online surveys; *D* refers to the number of records for which a given category of tourist profiles or nature-based experiences was not indicated in both content analysis and online surveys; *n* is the total number of photos.

The independency between the classifications from the content analysis and online surveys was evaluated by means of the Pearson chi-square analysis of independency, tested against the hypothesis that the classifications from content analysis and online surveys are statistically independent (i.e. showing no evidence of association or relationship). The interrater agreement between classifications was computed by means of the Cohen's kappa coefficient. A statistically significant value ($p < 0.05$) for Cohen's kappa suggests that the amount of agreement between content analysis and online surveys is higher than an agreement expected to occur by chance (Allouche et al. 2006).

2.4.2. Congruence between content analysis and online surveys classifications for individual categories

For each individual category of tourist profiles and nature-based experiences, we further calculated the Precision, Recall and the F1 scores between the classifications of the content analysis and online surveys (Powers 2011). Results were organised in a confusion matrix (Table 1) constructed for each individual category of tourist profiles and nature-based experiences (cf. Table S1, supplementary material). The matrix considered the amount of photos matching a given category "i" in both content analysis and online surveys (A, in Table 1); the number of photos mismatching a given category "i" in both content analysis and online surveys (B and C, in Table 1) and the number of photos not attributed to the category "i" in both content analysis and online surveys (D, in Table 1) .

		Online surveys	
		Category "i"	Other category but "i"
Content analysis	Category "i"	$A_{(category\ i)}$ [match]	$B_{(category\ i)}$ [mismatch]
	Other category but "i"	$C_{(category\ i)}$ [mismatch]	$D_{(category\ i)}$ [match]

Table 1. Example of a confusion matrix used to compare the classification of photos from the content analysis and online surveys considering each individual category of tourist profiles and nature-based experiences.

From the construction of this confusion matrix, a series of metrics (Sokolova and Lapalme, 2009) to analyse matches and mismatches for each category: Precision referred to the number of photos which match the same category in both content analysis and online surveys classifications, weighted by the number of photos assigned to that category in the content analysis classification (eq. 5); Recall (or sensitivity) expressed the number of photos matching the same category in content analysis and online surveys, weighted by the number of

photos assigned to that category in the online surveys classification (eq. 6); F1 score indicated the weighted average of Precision and Recall (eq. 7), taking into consideration the non-matching cases between both content analysis and online surveys classifications. Details on these metrics, including on their calculations, interpretation and relation with our research hypotheses are shown in table 2.

$$\text{Precision}_{(\text{category i})} = A_{(\text{category i})} / A_{(\text{category i})} + B_{(\text{category i})} \quad \text{(Eq. 5)}$$

$$\text{Recall}_{(\text{category i})} = A_{(\text{category i})} / A_{(\text{category i})} + C_{(\text{category i})} \quad \text{(Eq. 6)}$$

$$\text{F1 score} = 2*(\text{Recall} * \text{Precision}) / (\text{Recall} + \text{Precision}) \quad \text{(Eq. 7)}$$

Results from content analysis and online surveys classifications are shown throughout the manuscript as bar plots. Statistical computations were implemented in R software (R Core Team 2019).

3. Results

3.1. Prevailing tourist profiles and nature-based experiences across test areas

The classifications obtained from the content analysis and online surveys showed different distributions in the number of photos assigned to each category of tourist profiles and nature-based experiences (Figure 3). Examples of photos assigned to the "landscape and species" category in the content analysis included close-ups of animals and plants or wide views of natural landscapes. "Culture and heritage" included photos dominated by traditional infra-structures (e.g. monuments) or cultural activities (e.g. gastronomic features). "Recreation and sports" photos focused on sports (e.g. ski equipment or people riding a bike) or recreational activities (e.g. beach leisure or barbecuing).

Metric	Calculation	Explication	Interpretation	Related hypothesis
Global agreement	(A / n) * 100	A is the number of cases in which content analyses and online surveys result in the classification of the same category (e.g. both agree that the record is focused on landscapes) n is the total number of cases	This metric illustrates the matches between content analysis and online surveys classifications, given their agreement on identifying the same category, weighted by the total number of observations.	H2
Global accuracy	((A + D) / n) * 100	D is the number of cases in which the content analyses and online surveys agree that the classification in not on a given category i(e.g. both agree that the record is not focused on landscapes)	This metric illustrates the matches between content analysis and online surveys classifications, given their agreement on not identifying the same category, weighted by the total number of observations.	H2
Precision $_{(\text{category i})}$	$A_{(\text{category i})} / A_{(\text{category i})} + B_{(\text{category i})}$	B is the number of records in which content analyses classification is on category “i” but online surveys is not on category “I”.	Precision is the ratio of matches between content analysis and online surveys for an individual category. It expresses the number of times content analysis converged with the classification of online surveys for a given category.	H3
Recall $_{(\text{category i})}$	$A_{(\text{category i})} / A_{(\text{category i})} + C_{(\text{category i})}$	C is the number of records in which online surveys classification is on category “I” but content analyses classification in not on category “I”.	Recall is the ratio of matches between online surveys and content analysis It expresses the number of times online surveys converged with the classification of content analysis for a given category	H3
F1 score	2*(Recall * Precision) / (Recall + Precision)	-	F1 Score is the weighted average of Precision and Recall. F1 Score is a metric to evaluate each category individually, as a metric of matches between content analysis and online surveys (and vice-versa) for an individual category	H3

Table 2: Details on the metrics used to measure the congruence between content analyses and online surveys classifications and their relation with the research hypotheses.

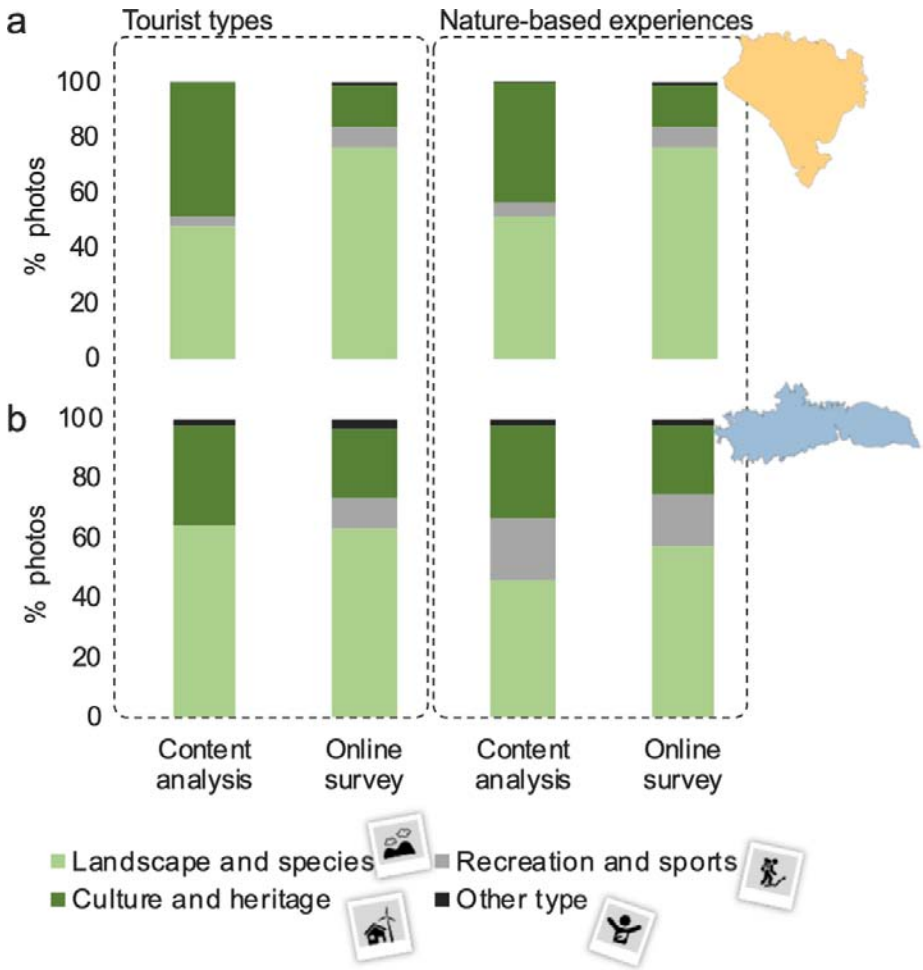

Figure 3. The proportion of photos assigned to each category of tourist profiles and nature-based experiences based on the content analysis and online surveys in Doñana (a) and Sierra Nevada (b).

The content analysis of tourist profiles in Doñana (Figure 3a) revealed the dominance of photos assigned to "landscape and species" and "culture and heritage" categories (48 % of all photos, each), followed by "recreation and sports" (4 %) and "other type" (<1 %). Although the online surveys classification showed a similar trend, the amount of photos assigned to "landscape and species" (77 %) and "recreation and sports" (7 %) by the Flickr users was almost twice of that from content analysis. For Sierra Nevada (Figure 3b), content analysis showed the

dominance of “landscape and species” (41 %), followed by “culture and heritage” categories (32 %), “recreation and sports” (25 %) and “other type” (2 %). “Recreation and sports” (11 %) categories were less indicated the content analysis. By contrast, “culture and heritage” (24 %) were more indicated in the context analysis.

The content analysis of nature-based experiences in Doñana (Figure 3a) also showed the prevalence of “landscape and species” (51 %) and “culture and heritage” (43 %) categories, followed by “recreation and sports” (5 %) and “other type” (<1 %). Both “landscape and species” (76 %) and “recreation and sports” (8 %) categories were more indicated in online surveys, whereas “culture and heritage” (16 %) were less indicated by the Flickr users. Contrastingly, for Sierra Nevada (Figure 3b), the online surveys classification indicated less “recreation and sports” (17 %) compared to the results obtained from the content analysis. “Landscape and species” was found to be the dominant category, followed by “culture and heritage” in both content analysis (46 % and 31 %, respectively) and online surveys classifications (58 % and 23 %, respectively).

3.2. Overall congruence between content analysis and online surveys

Different agreement and accuracy levels were found between content analysis and online surveys classifications, depending on the Biosphere Reserve (Figure 4). Results for tourist profiles in Doñana, showed that in 56 out of 100 cases matched the same category in both content analysis and online surveys (i.e. 56 % agreement level). In 78 % of all cases, the content analysis was able to identify and exclude a given category in the same way as in online surveys (i.e. 78 % accuracy level). Despite an apparent higher congruence between content analysis and online surveys for Sierra Nevada compared to Doñana (Figure 3), lower congruence values were found, with only half of all cases matching the same category in both content analysis and online surveys (41 % agreement). The

content analysis identified and excluded a given category in the same way as in online surveys in 67 % of all cases (Figure 4b).

The test of independence (Chi-square = 22.36) and a confusion matrix based agreement measure (Kappa = 0.23) between the content analysis and online surveys classifications resulted in statistically significant values ($p < 0.001$) for Doñana, suggesting a significant association and agreement between content analysis and online surveys classifications on tourist profiles. For Sierra Nevada no significant results were found (Chi-square = 14.97; Kappa = 0.04; $p > 0.05$).

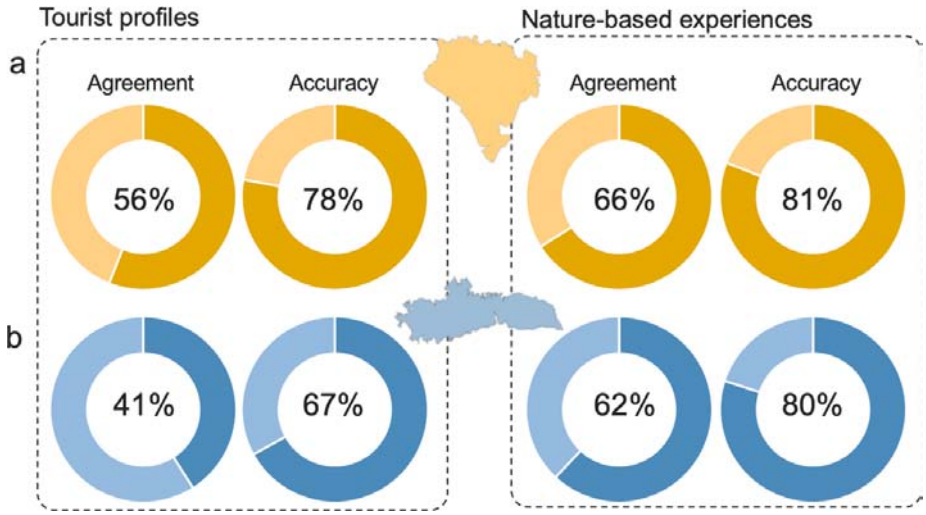

Figure 4. General agreement and accuracy levels between the classification results from content analysis and online surveys on tourist profiles and nature-based experiences in Doñana (a, top of the figure) and Sierra Nevada (b, bottom of the figure).

For nature-based experiences, higher agreement (66 %) and accuracy (81 %) values were found between content analysis and online surveys in Doñana (Figure 4a) and Sierra Nevada (Figure 4b). Additionally, the results of the independence and inter-agreement tests showed a significant ($p < 0.001$) association and inter-agreement between content analysis and online surveys classifications for Doñana (Chi-square = 22.36; Kappa = 0.30) and Sierra Nevada (Chi-square = 63.11; Kappa = 0.31).

3.3. Tourist profiles and nature-based experiences in content analysis versus online surveys

When analysing the tourist profiles in Doñana by comparing the categorization of content analysis of Flickr photos and the online surveys answers, low congruence levels were observed for each individual category of tourist profiles in Doñana (i.e. < 0.50; Figure 5). An exception was found for the "landscape and species" category, showing a high F1 score (0.69), a very high Recall (0.93), and a moderate Precision (0.55). This suggests that among all photos assigned by the users to the "landscape and species" category in the online surveys, 93 % matched the result from the content analysis conducted by use. However, among all the photos assigned to that category by us through the content analysis, only 55 % matched the classification provided by the Flickr users during the online surveys. Also, the category "culture and heritage" showed a high Precision value (0.90), but low Recall and F1 score. For Sierra Nevada, the highest congruence level was also detected for "landscape and species", which showed a moderate F1 score (0.57) with a fairly high Precision (0.68).

Similar trends were found when analysing the congruence between content analysis and online surveys classifications for each individual category of nature-based experiences. In Doñana, "landscape and species" showed the highest values for F1 (0.75), Precision (0.94), and Recall (0.62). In fact, these scores were also higher than those previously obtained for tourist profiles. A similar pattern was observed for Sierra Nevada, with the category "landscape and species" revealing the best congruence between content analysis and online surveys, with high F1 (0.73), Precision (0.88) and Recall (0.63) scores. "Culture and heritage" showed also a moderate congruence (F1: 0.52) with a high Recall value (0.71) in Sierra Nevada (Figure 5).

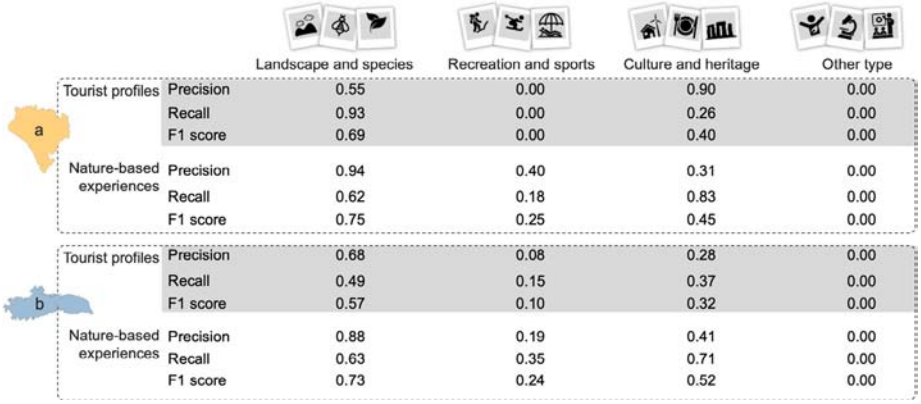

Figure 5. Precision, Recall and F1 scores obtained for the congruence analysis between content analysis and online surveys classifications on tourist profiles and nature-based experiences in Doñana (a) and Sierra Nevada (b).

4. Discussion

4.1. Tourist profiles and nature-based experiences between Biosphere Reserves

Our descriptive analysis showed different distributions in the number of photos assigned to each category of tourist profiles and nature-based experiences between the classifications conducted by us in the content analysis and those indicated by Flickr users during the online survey (see section "Prevailing tourist profiles and nature-based experiences across test areas"). In both Biosphere Reserves (Doñana and Sierra Nevada), "landscape and species" and "culture and heritage" were the most represented categories of tourist profiles and nature-based experiences regardless of the classification method (i.e. content analysis or online surveys; Figure 3).

These results seem to agree with other studies (e.g. Hausmann et al. 2018; Martínez Pastur et al. 2016; Richards and Friess, 2015). For instance, Martínez-Pastur (2016) found that more than 83 % of all photos shared on social media expressed settings with aesthetic

and existence values associated to "culture and heritage" in Patagonia. Also, Hausmann (2018) showed the dominance of "biodiversity and landscape" photos shared on Instagram (ca. 61 % of all photos) and Flickr (89 %) platforms for the Kruguer National Park. Finally, Richards and Friess (2015) assigned more than 60 % of all photos to a category expressing "nature appreciation and landscape" in urban mangrove sites from Singapore.

The dominance of "landscape and species" and "culture and heritage" photos is also congruent with the natural and cultural capital of Doñana and Sierra Nevada. Doñana includes natural wetland landscapes (e.g. marshes, lagoons and dune ecosystems) and a diversity of species (e.g. birds and emblematic mammals) which are popular for many visitors. Doñana is also the place of many cultural and religious traditions which have become internationally known (García and Marín, 2005). Similarly, due to its altitudinal range, Sierra Nevada holds remarkable topographic landscapes, which are the habitat for a high and peculiar biodiversity (Zamora et al. 2016). Sierra Nevada also includes a cultural legacy with elements of historical human practices, traditions and activities (e.g. handcrafted products and archaeological remains) of touristic importance.

Conversely, "recreation and sports" was less represented compared to the remaining categories (Figure 3) in Doñana. This was a rather surprising result, given that Doñana offers many opportunities for recreation activities and sports, namely through beach-oriented activities (García and Marín, 2005). In the case of Sierra Nevada, "recreation and sports" was found to be particularly pertinent in content analysis classification, in which a diversity of recreation and sport activities, such as hiking and skiing, could be identified (Gómez-Ortiz et al. 2013). However, "recreation and sports" was underrepresented in the results from online surveys (compared to content analysis). This result suggests a plurality of nature contributions to tourists when exploring multi-functional landscapes such as the ones included in

Sierra Nevada (Martín-López et al. 2012). For instance, visitors may simultaneously capture cultural elements in their photos, while being involved in "recreational and sports" or while enjoying "landscape and species".

4.2. Matches and mismatches between content analysis and online surveys

When evaluating the overall congruence between the results retrieved from our photo content analysis and from Flickr users' surveys, in general, we found poor to medium agreement and accuracy levels (see section "Overall congruence between content analysis and online surveys"). This suggests that the elements interpreted from the photo content may not always match the stated-preferences expressed in the online surveys. Nevertheless, higher congruence values were observed for nature-based experiences compared to tourist profiles (Figure 4). Differences in the interpretation of human-nature interactions in content analysis versus online surveys have also been shown for other protected areas (Hausmann et al. 2018; Heikinheimo et al. 2017). Our result may suggest that it might be easier to interpret a nature-based experience from a photo (i.e. "the what") than to infer on the social profile of the tourist (i.e. "the who"). In fact, most content analysis studies tend to focus on the classification of nature-based experiences and activities in the wild (e.g. Van Zanten et al. 2016).

Our results seem to change with the social-ecological context, with higher congruence levels between content analysis and online surveys for Doñana compared to Sierra Nevada (Figure 4). Previous studies have suggested the influence of the social-ecological context in people's preferences for nature benefits (Martín-López et al. 2012). Sierra Nevada includes a complex territory (due to its topographic heterogeneity and land use diversity (Zamora et al. 2016)), potentially supporting a variety of nature-based experiences and making them harder to interpret from a photo content.

Also, our study shows that the agreement level between content analysis and online surveys classifications depends on the category being analysed (Figure 5). In fact, rather matching results, in terms of Precision, Recall and F1 scores, between content analysis and online surveys were only found for the category "landscape and species". This observation not only suggests that most photos classified in the content analysis as "landscape and species" match the online surveys classification (Precision), but also that one can predict a good percentage of photos classified as "landscape and species" by online surveys (Recall). The consistency found for this category may be explained by the fact that "landscape and species" express the most common tourist profile and their nature-based experiences when visiting the Biosphere Reserves. This inevitably makes "landscape and species" as the most-stated category in the online surveys, as well as the most easy-to-recognise category in the content analysis (particularly when the content analysis is performed by ecologists or nature-oriented researchers).

4.3. Methodological considerations and limitations

Here we identified differences in the classification of tourist profiles (i.e. "the who") and nature-based experiences (i.e. "the what"), as obtained from online surveys to Flickr users and from our content analysis of the photos posted by those same users, in two Biosphere Reserves: Doñana and Sierra Nevada. We found the lack of a clear congruence between content analysis and online surveys, but also that this congruence depends on the category of nature-based experience under analyses and their social-ecological context. This suggests that although content analysis and online surveys alone can lead to incomplete information, their combined use can provide a more holistic evaluation of natural and cultural indicators.

We are nevertheless aware that any method tested here, or their combination, cannot be seen as flawless and that other methods were not considered (e.g. in situ survey). Yet, using methodologies based on

social media networks, either content analysis or online surveys, can add complementary information to that obtained through more traditional state-preference methods. Among others, they facilitate the acquisition of thematic and geographical information through large areas and across time. They can also be cost-effective methods with increasing number of users, allowing replication and to reach large audiences. Therefore, it is recommended that the management of recreation in protected areas combine all these methods in an optimized protocol, adapting them according to their geographical, social and environmental reality. Maybe a way to integrate the information of both sources can be operationalized through the Cultural Salience Index proposed by Vieira et al. (2018), in which a given cultural ecosystem service (or nature-based experience) is evaluated from different user groups based on a ranked list.

Still, some methodological considerations are recognised in social media data. Despite the amount of photos taken in a given area, social media users make decisions on which photos they share in social networks. This does not necessarily mean that the photos shared online express the most preferred and valued elements of the landscape (e.g., selfies over particular species to serve as social testimonies of the user presence in the protected area). As suggested by Malik (2015), different dimensions influence photo sharing in social networking, namely, affection, attention seeking, disclosure, habit, information sharing, and social influence, behind sharing digital photos.

Also, we are aware that our research could have represented some bias due differences in time when the photo was taken and questionnaire was administered to the same user. Nevertheless, we are confident that the way we approached the Flickr users in the questionnaire could have contributed to diminish this bias. As noted by Kim (2018), there is a direct and positive relationship between the memorable tourism experiences and the intention to share them with others. Also, Tung and Ritchie (2011), highlighted that recollection (activities as sharing photos) can be amongst the most important dimensions to help memorizing tourism experiences.

Also, there is a broad literature that analyses the biases in social media data and we assume that our sample has the same bias in terms of geographical accuracy or mobile coverage (Heikinheimo et al., 2017), socio-economic factors (i.e.: age, gender and income level) (Hausmann et al., 2018; Oteros-Rozas et al., 2018) or the availability to detect less popular activities (Heikinheimo et al., 2017).

Furthermore, stated-preferences for given tourist profiles, either online or face-to-face, can change in time and space, meaning that a given social media user may consider him/herself as a tourist of type *A* in a given time period, but as a tourist of type *B* in another time period. As highlighted by Hausmann et al. (2018), understanding how users' profiles and nature preferences change through time could be important to support continuous monitoring. The choice of which and how many categories are stayed in the questionnaire depends not only on the words, concepts and definitions used in the survey, but also on human psychological and cognitive factors, such as perceptions, judgements and attitudes. The former change in time were not considered in our analyses. In this sense, methodologies such as the critical incident proposed in e.g. Moreno-Llorca (2019) could be used to extract non-conditioned expressions of users experiencing or enjoying an activity in nature.

4.4. Research perspectives

We are confident that this study opens the possibility of future researches. It would be interesting to analyse the reasons which explain the matches and mismatches found between content analysis and online surveys, and also investigate those matches and mismatches form a spatial perspective. In addition, it would be enriching in the future to undertake a complementary and triple analysis, including on-ground surveys. These complementary insights would allow including both the interpretation from the researcher (i.e. the user interpreting the photo) and the information from the nature user

(i.e. the person taking the picture). A way to consider such a complementary information can be found in the development of the salience index (Vieira et al. 2018). Further progress in combined assessments should consider multidisciplinary teams of researchers (e.g. from natural and social sciences) as well as managers' participation (Enquist et al. 2017), and include information from wider social media platforms (besides Flickr) and a spatially-explicit component. This would make it easier to better interpret and communicate the information provided by the visitors, either through social media content analysis or stated-methods and indicators. In this context, an exploratory analysis of the users' vocabulary used to tag social media photos could be a promising approach (Qian et al. 2013). Advances in culturomics, namely through text sharing analysis, will also show promising contributions in this regard (Ladle et al. 2016).

Nevertheless, caution should be made when extrapolating the results from our study to other areas. Several studies have evaluated visitor trends and their experiences in protected areas based on the analysis of photo content shared on social networks (Martínez Pastur et al. 2016; Oteros-Rozas et al. 2018; Richards and Friess 2015). Some of them compare the results of the content analysis with the results obtained in questionnaires carried out by visitors of the study area (Hausmann et al. 2018; Heikinheimo et al. 2017). However, many of these studies differ from ours given their use of distinct categorisations or social media platforms and target populations (Heikinheimo et al. 2017; Oteros-Rozas et al. 2018).

5. Concluding remarks

Our approach provided preliminary insights on the comparison between information collected through the content analysis of social media photos and the stated preferences of social media users in online surveys. In brief, our results suggest that the identification of tourist

profiles and nature-based experiences obtained through the content analysis of social media photos differs from the information stated by social media users in online surveys. Still, the magnitude of these differences may not only depend on the category under analysis, but also on the social-ecological context of each Biosphere Reserve. Therefore, these results suggest that the elements interpreted from the photo content may not always match the stated-preferences expressed in the online surveys (and vice-versa). The combined use of content analysis and online surveys should thus be encouraged to obtain more holistic insights on nature-based experiences and preferences, as well as the use of on-the-ground surveys to analyse sampling biases and understand visitors' motivations. Our results can be particularly important in a time in which the use of data from social media is increasingly rising to monitor human-nature interactions (Di Minin et al. 2015; Ladle et al. 2016; Richards and Friess 2015; Hale et al. 2019), including the assessment of cultural ecosystem services (Martínez Pastur et al. 2016) and the development of machine learning techniques for photo content analysis (Gosal et al. 2019; Lee et al. 2019).

Chapter 3

Social media photo content for Sierra Nevada: a dataset to support the assessment of cultural ecosystem services in protected areas

Ros Candeira A, Moreno-Llorca R, Alcaraz-Segura, D, Bonet-Garcia, FJ. 2020.

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Abstract

This dataset provides crowd-sourced and georeferenced information useful for the assessment of cultural ecosystem services in the Sierra Nevada Biosphere Reserve (southern Spain). Data were collected within the European project ECOPOTENTIAL focused on Earth observations of ecosystem services. The dataset comprises 778 records expressing the results of the content analysis of social media photos published in Flickr. Our dataset is illustrated in this data paper with density maps for different types of information.

Keywords

Biosphere reserve; cultural ecosystem service; nature-based experience; social media content; social-ecological research

1. Introduction

The modern human epoch is characterised by dynamic social-ecological changes, with local communities and individuals showing an important role in ecosystem integrity and health (Rands et al. 2010). In this context, nature conservation mechanisms in protected areas have been increasingly re-shaped to accommodate social aspects of ecosystems (Chan et al. 2006). The establishment of a global network of Biosphere Reserves (UNESCO) is an emblematic effort in this regard, being established to promote strategies that reconcile biodiversity conservation with the sustainable use of ecosystem services (Reed 2016).

Ecosystem services are generally known as the contributions that get from nature (MEA 2005). They include raw material from ecosystems, recognised as provisioning services (e.g. timber and food), and the results from ecological functioning (e.g. hazard mitigation and pollination), i.e. regulating ecosystem services (MEA 2005). Ecosystems also offer non-material benefits, known as cultural ecosystem services, e.g. through recreational and inspirational activities (Fish et al. 2016). Despite increasing focus on ecosystem services, assessment approaches have been particularly challenging for cultural ecosystem services (Blicharska et al. 2017).

Evaluations of cultural ecosystem services have been struggling with the inability to capture their subjectivity and utilitarian value (Fish et al. 2016). Conventional assessments include, for instance, the use of public polls which are often expensive and show limited spatio-temporal coverage, as well as biodiversity mapping, that tends to merely capture the potential supply of cultural services (Blicharska et al. 2017). In the "information age", the use of big data from social media has become a promising approach to monitor nature-based experiences associated to cultural services (Hausmann et al. 2017).

A plethora of social media information has been produced and shared at unprecedented rates, revolutionising traditional methods to address human culture (i.e. culturomics; Ladle et al. 2017), including in the light of conservation problems (see Ladle et al. 2016 for a review). Closely related to culturomics is the content analysis of digital photos posted and shared in social media platforms, such as Flickr (Richards and Friess 2015). These photos contain geographic and temporal information, allowing to map cultural ecosystem services, at high spatial resolutions and for specific time periods in a straightforward and fast way (Vaz et al. 2018).

Despite increasing evaluations of social media information, there is a general deficiency of publicly available databases of photo content analysis. Analysing and mapping the cultural value of ecosystems allows to identify and locate places where nature most contribute to cultural identity and heritage, human health, environmental education, and opportunities for nature enjoyment (Soga and Gaston 2016). Under appropriate management strategies, those places can provide great opportunities to promote social support for nature conservation alongside the sustainable use of Biosphere Reserves (Infield 2001).

Our expectation describing and making available this dataset is to promote the sharing of other similar datasets in order to locate, describe and quantify potential cultural services in protected areas worldwide.

2. Project details

The dataset was compiled within the context of the H2020 project "ECOPOTENTIAL: improving future ecosystem benefits through earth observations" (http://www.ecopotential-project.eu), which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 641762. ECOPOTENTIAL is focused on internationally recognised Protected Areas, blending Earth Observations, data analysis and modelling of

current and future ecosystem conditions and services. ECOPOTENTIAL considers cross-scale geosphere-biosphere interactions at regional to continental scales, addressing long-term and large-scale environmental and ecological challenges.

3. Spatial coverage

General spatial coverage

The dataset covers a 1,722 km^2 area corresponding to the UNESCO Biosphere Reserve Sierra Nevada. Sierra Nevada is a mountainous region located in Andalusia (Granada and Almería provinces), in southern Spain. The altitude ranges from 860 m a.s.l to the summits, where the highest peak reaches 3,479 m a.s.l. The climate is Mediterranean, presenting cold winters and hot summers, with pronounced summer drought (July-August). The annual average temperature decreases in altitude from 12-16ºC below 1,500 m to 0ºC above 3,000 m a.s.l., and the annual average precipitation is about 600 mm. Annual precipitation ranges from less than 250 mm in the lowest parts of the mountain range to more than 700 mm in the summit areas, where above 2,000 m of altitude winter precipitation is mainly in the form of snow. Topographically is a heterogeneous area, with strong climatic contrasts between the sunny, dry south-facing slopes and the shaded, wetter north-facing slopes.

Sierra Nevada hosts more than 80 endemic plant species (Blanca et al. 2001) and more than 2,300 taxa of vascular flora in total, representing the 33.2% of Spanish flora (Lorite 2016), being among the most important biodiversity hotspots in the Mediterranean region (Blanca et al. 1998). Overall, Sierra Nevada comprises 27 habitats types from the habitat directive, as well as 31 fauna species (20 birds, 5 mammals, 4 invertebrates, 2 amphibians and reptiles) and 20 plants species listed in the Annex I and II of habitats and birds directives. Besides being included in a biosphere reserve, Sierra Nevada has additional legal protections: Special Protection Area and Site of Community Importance (Natura 2000 network); and National and Natural Park.

Regarding its general socioeconomic characteristics, there are 61 municipalities with 90,048 inhabitants in 2017. The population average age is 48.3 years (ten years greater than the population of large urban areas closer to the national park). The main economic activity is services, mostly related to rural tourism (45% of people employed, 75% of registered businesses). Secondary economic activities are farming and construction sector (25% of people employed each one). Finally, the percentage of people working in industrial sector stands around 5%. Registered unemployment in relation to total population is lower than the urban areas (9.3% versus 10.1%) but the net income per inhabitant is half that of urban areas (3,597€ versus 7,158€) (SIMA 2019).

Coordinates

36° 55' 04"N and 37° 14' 25"N Latitude; 3° 36' 26"W and 2° 35' 41"W Longitude

Temporal coverage

1972–2017

4. Methods

Sampling description

We focused on the screening of photos from a popular social media platform: Flickr (https://www.flickr.com). We used the application programming interface (API) in Flickr (https://www.flickr.com/services/api/) to collect publicly available information published by the users. To protect the users, the obtained information was kept anonymised through the study. Using this API, we collected geographically referenced social media data indicating a time window (between the start of Flickr in 2004 and 2017) and a bounding box with pair of coordinates around our test area. After transforming the

output JSON/XML files to .XLS format, we geoprocessed the data using a GIS in order to clip only those data points included within our case Biosphere Reserve boundaries and to prepare them for the content analysis of random stratified samples (see below). A total of 20,048 photos were downloaded and their information was stored as an excel file with the following attributes: date, latitude, longitude, and picture Uniform Resource Locator (URL).

We stratified our sampling over four strata differing in their nature protection regime (National versus Natural Park) and tourist dynamics (rural versus recreational tourism). Specifically, we randomly selected a set of 210 photos across the limits of the National Park (corresponding mostly to the area with the highest elevation of the Biosphere), and another set of 210 photos within the remaining area coincident with the Natural Park. A third set of 210 photos was considered across ski resorts, corresponding to areas with the highest movement of visitors in autumn and winter. The remaining photos (n = 259) were selected considering the rural areas of the reserve, which are expected to host more visitors during spring and summer. Our final dataset comprised 778 photos from 708 different Flickr users.

Method step description

We checked each individual photo (n = 889) to evaluate its suitability for the content analysis: unidentifiable photos (e.g. due to poor quality) or photos capturing non-natural and indoor elements (e.g. inside parking places or private and business properties) were not considered for the content analysis. Also, photos which were not available, for instance, since they were eliminated or protected by users' rights, were also not analysed. After applying the former exclusion criteria, we conducted a "directed content analysis" (following e.g. Hsieh and Shannon 2005; Martínez-Pastur et al. 2016; Oteros-Rozas et al. 2017). For this purpose, we manually classified each photo (n = 778), based on predefined categories (see Table 1). The photo content analysis was

first conducted considering the main feature or topic dominating in each photo indicated in the "Main content" variable, which categories express key cultural elements from ecosystems contributing to the use of cultural ecosystem services by people, in agreement to the new Common International Classification of Ecosystem Services (Haines-Young and Potschin 2018). These categories were associated to each photo, considering the main photographic focus on: fauna and flora or nature and landscape features, as well as on cultural, religious, rural, sport, gastronomy and recreation elements. In cases in which more than one feature or element could be recognised in the photo, we used more than one category to classify the photo. The order of the key elements which define the topic of the photo was based on the album/roll of the user. Specifically, the first topic considered was the element that was identified as the most frequently photographed by the user. The remaining topic was indicated as a secondary category.

In order to provide more detailed information about the photo's content, we further classified each photo considering: (1) The main nature and human features represented in the photo (e.g. lake, natural forest, mountain peak, etc.). Again, more than one category per variable could be attributed in cases in which an individual photo showed the dominance of different nature and human features. (2) The type of prevailing sport activity (e.g. hiking, horse riding, etc.), when one of the main topics of the photo was "Sports". (3) The represented faunal groups (e.g. ungulate, insect, etc.), in those cases in which the main content of the photo was focused on fauna (e.g. categories "Fauna/Flora" and "Birdwatching"). Therefore, these last two variables (Sport activities and Faunal groups) depended on the classification attributed to the first variable "Main content".

Variable	Category	Description
General information of the photo		
Coordinates	Latitude of the photo	Coordinate reference system: EPSG 4326-WGS 84
	Longitude of the photo	Coordinate reference system: EPSG 4326-WGS 84
Date	The date when the photo was taken	Format: day/month/year
Main content of the photo		
Main content	Birdwatching	A bird or group of birds are the main content of photo
	Fauna/Flora	Fauna and/or flora are the main content of the photo
	Nature & Landscape/ Seascape	The photo is mainly focused on nature or landscapes/seascapes in general
	Cultural	Cultural elements are the main content, including harvest of pine nuts or traditional buildings
	Religious	Religious elements are the main content, including processions, pilgrimage, churches, carriages or carts as part of pilgrimage
	Rural	Elements associated to rural tourism are the main content, including lodges, rural activities, villages or other related infrastructures
	Sports	Sports elements are the main content, such as those associated to biking, hiking or running
	Gastronomy	Gastronomy is the main content of photo, including dining at restaurants or traditional products
	Recreation	The main content of the photo is on recreational areas or similar public infrastructures, including barbecues or playgrounds
	Other type	The photo is dominated by other elements that are not related with the former categories
Detailed content of the photo		
Sport activities	Alpine skiing	Alpine skiing is the topic of photo
	Cross country skiing	Cross country skiing the topic of photo
	Climbing	Climbing is the topic of photo
	Road cycling	Road cycling is the topic of photo
	Mountain cycling	Mountain cycling is the topic of photo
	Downhill cycling	Downhill cycling the topic of photo
	Running	Running is the topic of photo
	Hiking	Hiking is the topic of photo
	Paragliding	Paragliding is the topic of photo
	Horse riding	Horse riding is the topic of photo

	Canoeing	Canoeing is the topic of photo
	Other type	Other type of sport activity is the main topic of photo
	Not applicable	The photo is not focused on any sport activity
Nature and human features	High mountain	High mountain is the topic of photo
	Mid-mountain	Mid-mountain is the topic of photo
	Mountain peak	Mountain peak is the topic of photo
	Horizon	Horizon is the topic of photo
	Natural forest	Natural forest is the topic of photo
	Anthropic forest	Anthropic forest is the topic of photo
	Shrub	Shrub is the topic of photo
	Grassland	Grassland is the topic of photo
	Lake, pond	Lake is the topic of photo
	River	River is the topic of photo
	Sky	Sky is the topic of photo
	Urban/built environment	Urban/built environment is the topic of photo
	Non-urban/built environment, infrastructures	Non-urban/built environment, infrastructure, is the topic of photo (e.g., rural infrastructure, refuges and recreation infrastructure)
	Humans, selfies	People, including selfies, are the topic of photo
	Other type	Other type of feature is the main topic of photo
	Not applicable	These categories are not applicable
Faunal groups	Mammal	Mammal is the topic of photo
	Ungulate	Wild ungulate is the topic of photo (e.g., Iberian ibex)
	Waterbird	Waterbird is the topic of photo
	Wader	Wader is the topic of photo
	Raptor	Raptor is the topic of photo
	Passerine	Passerine is the topic of photo
	Reptile	Reptile is the topic of photo
	Fish	Fish is the topic of photo
	Insect	Insect is the topic of photo
	Other type	Other type of fauna is the main topic of photo
	Not applicable	The photo is not focused on any type of fauna

Table 1. Variables and categories considered for the classification of social media photo content, including their description and classification criteria.

Quality control description

The classification of photos into the above-mentioned categories was evaluated by two independent users. Before analysing the content of the whole dataset, a test set of 100 randomly chosen records was first considered and classified. After analysing this test set, the classification procedure was refined for a second round. For both classification rounds, the consistency between the two users was analysed through general agreement and kappa statistics. The statistics indicated an increase of classification consistency from the first to the second test set. Specifically, a good consistency between users was found, with agreement levels ranging between 65% (sport activities) and 88% (faunal groups), and kappa values between 0.58 (nature and human features) and 0.60 (sports activities).

Dataset overview

Figure 1 shows the spatial location of the photos considered in the dataset. The eastern part of Sierra Nevada is by far represented by a higher volume of photos, as indicated by warmer colours. This pattern seems to match the location of sky resorts and rural villages (the "Alpujarras"), which are characterised by a high touristic demand in the Biosphere Reserve. Several other photos are widely represented in westernmost regions of Sierra Nevada. In this case, the location of pictures seems to coincide with the prevalence of walking trails in the Biosphere Reserve.

This spatial pattern is also evident for the different categories assigned to the dataset (Figure 2). An exception is rather observed for the faunal groups variable, in which a relative density of photos is also represented in western regions of the Biosphere Reserve.

We are confident that our dataset (and derived maps) add detail on the potential location of different cultural contributions to people. Specifically, the spatial projections derived from this study can inform management decisions, e.g. on prioritising land planning efforts

and resources (Krishnaswamy et al. 2009). They can also be used to maximize synergies between biodiversity conservation and cultural values (Turnhout et al. 2013), identify conflicting areas (or disservices) emerging from recreational activities (such as skiing) tourism and strictly protected zones (with protected habitats/species; Van Cuong et al. 2017), support the monitoring of the natural and cultural capital through remote observations (i.e., "Digital conservation"; Arts et al. 2015), and assist on data collection and dissemination for scientific research and evidence-based conservation (Sherren et al. 2017).

Despite the usefulness of our dataset, some considerations must be recognised when using this, and other similar datasets, in the cultural services' arena. For instance, the spatial reference precision of social media photographs can bias the geolocation of collected data (Figueroa-Alfaro and Tang 2017). Still, this issue was likely insignificant in our study, due to the illustration of photographs through a Kernel function (i.e., as a heat-map). We are also aware that distinct social media platforms (such as Instagram, Panoramio) have different audiences, users, and temporal/spatial characteristics, which affects the way they can be used (Van Zanten et al. 2016). In our study, we adopted the Flickr platform, due to its more nature-oriented users, ease of data analyses, and broad spatial and temporal coverage. Nevertheless, we encourage the inclusion of different types and sources of social media information that can be complementary to the dataset we propose (Oteros-Rozas et al. 2018). Furthermore, social media users make decisions on which photos they share in social networks, without necessarily meaning that the photos shared online express the most preferred and valued elements of the landscape (Malik 2015). Therefore, any effort to further understand the cultural preferences of social media users, should examine the motivations underlying their choices and perceptions in relation to other (social) determinants (e.g. socio-demography, economy), for instance, through traditional state-preference methods or even through social media natural language processing of picture comments. However, attention should be warranted when interpreting and communicating social patterns into more detail (Van Berkel et al. 2018). This was the main reason why our dataset does not compile, nor

analyse, data which was protected by users' privacy.

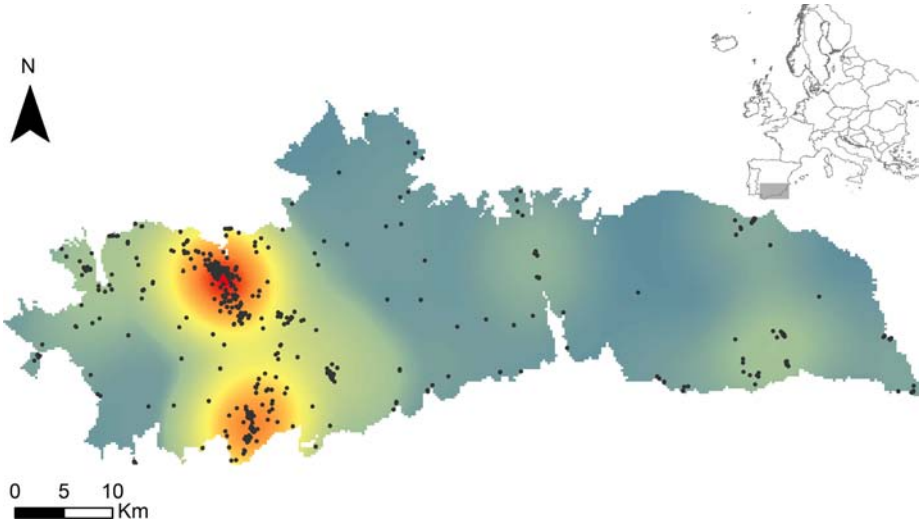

Figure 1. Location of Flickr photos considered in the dataset (n = 778). The location of each photo is represented by a dark circle. For visualization purposes, the map also shows heatspots of photos (kernel density), highlighting the areas with the highest and lowest photo densities in Sierra Nevada Biosphere Reserve.

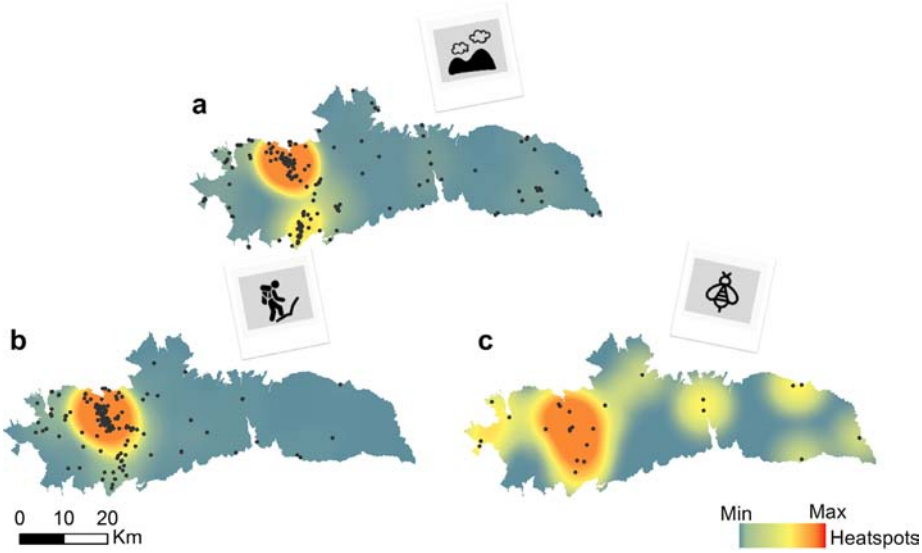

Figure 2. Illustration of Flickr photos showing: (a) nature & landscape as the main content, (b) sport activities and (c) faunal groups. The location of each photo is represented by a dark circle. The density of photos (kernel density) is also shown.

Dataset description

Object name	Georeferenced features of cultural ecosystem services in Sierra Nevada: a dataset based on social media photo content analysis.
Character encoding	UTF-8
Format name	CSV
Format version	v 1.0
Data published through	https://doi.org/10.6084/m9.figshare.8943509
Publication date of data	2019-07-17
Language	English
Licenses of use	This dataset is licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0) https://creativecommons.org/licenses/by/4.0/

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DE PUERTO LOBO
Puerto
Lobo

Chapter 4

A co-designed method to guide decision-making in protected area visitor centres

Moreno-Llorca R, García-Morales VJ, Lloréns-Montes JF, Ramos-Ridao ÁF, Alcaraz-Segura D, Navarrete J. 2018.

Nature Conservation

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Abstract

Protected areas (PAs) constitute the largest global effort for biodiversity conservation and the maintenance of ecosystem services. Science-based management, grounded in methods co-designed by scientists and managers, is necessary to improve the efficiency of PAs to achieve these goals and to promote sustainable development. Visitor centres (VCs) in PAs play an important role to facilitate the supply of recreational ecosystem services and to promote environmental awareness. In this study, scientists and managers co-developed a method to assess visitors' perceptions of the recreational activities carried out in VCs and how they depend on the type of visitors. The research was performed at 13 PAs in Andalusia (Spain). A questionnaire that measures users' satisfaction with the services provided by VCs was implemented in two phases: 1) selection of items through the critical incident technique, and 2) validation of the scale by using exploratory and confirmatory factor analysis. The main result is an instrument composed of 18 indicators classified into three dimensions: information, facilities and service received from personnel. The instrument provides additional information useful for managers, such as homogeneity of valuation throughout the PA network and sociocultural factors that may explain the differences in visitors' valuation. The instrument developed could either be used directly or adapted for recreation management in other similar PAs. The proposed methodology to be reproduced to validate other measurement instruments. This study illustrates how the development of a collaborative research method by scholars and practitioners can improve recreational management in PAs.

Keywords

Recreational management; Nature-based tourism; Co-production science; Ecotourism; Natural parks; Andalusia.

1. Introduction

Protected areas (PAs) constitute the largest global effort for biodiversity conservation (Jenkins & Joppa, 2009) and maintenance of ecosystem services (McNeely, 1994). Science-based guidance for managers is necessary to improve the effectiveness of PAs in conserving biodiversity, providing ecosystem services and promoting sustainable development. To this end, tools and methodologies that are co-designed by both managers and scientists are more successful than those developed in isolation (Enquist et al., 2017). To increase the probability of success, both managers and researchers must be involved in the process from start to end (López-Rodríguez et al., 2015). Scientists and managers must thus cooperate in defining the questions to be answered and the procedure for obtaining results useful for management through a scientific procedure. While time-consuming, this approach, termed translational ecology, increases the capacity to produce outcomes useful for decision-makers (Mauser et al., 2013).

In PA management, facilities such as visitor centres (VCs) are important to facilitating the supply of recreational ecosystem services (Kulczyk, et al., 2018) and performing different functions related to recreational activities. Their leading functions are interpreting, informing and educating visitors on values related to nature and on how to engage in recreational activities (Fallon & Kriwoken, 2003). VCs disseminate values, issues, stories and messages that influence appreciation of the PA and enhance the experience (Moscardo et al., 2000). Pearce (1991) notes that VCs offer distinctive landscape experiences, imaginative activities that extend beyond the facilities and a variety of distinctive experiences. In addition, visitor' activities in the centres foster their 'sense of place' and promote awareness of the local environment (Stewart, 1998). Uzun et al. (2017) link the decrease in the number of visitors to the PA in their study to closure of the VC, demonstrating the importance of VC management. Furthermore, many studies analyse the economic profits that enable sustainable

development of the population living in PAs due to promotion of recreation activities (Chae et al., 2012; Pandit et al., 2015 ; Samos & Cañete, 2013). Proper management of VCs can thus improve visitors' recreational experience and environmental awareness, and sustainable development of the PA.

Recreation in PAs has grown significantly in the last decade (Barros & Gudes, 2015; Hindsley et al., 2011), making nature recreation a major research issue (Pickering et al., 2018). Recreation research covers a wide range of topics on PAs. One of the most important objects of research has been the impact of these activities on the conservation of biodiversity (Azizi et al., 2011; Lawson etal., 2003 ; Monz et a., 2013 ; Prato, 2001) . To achieve sustainable recreational use of natural habitats, several studies focused on determining recreational carrying capacity (Baró et al., 2016; Maes et al., 2012; Wolff et al., 2015). VCs have also been the subject of several studies (Arabatzis and Grigoroudis, 2010; Do et al., 2015). Abu Bakar et al. (2016) analyse willingness to pay in Kubah National Park and Matang Wildlife Centre, and value (mainly monetary) assigned by visitors to recreational activities is a common area of study (Caparrós et al., 2017; Egan et al., 2015; Hjerppe et al., 2017). Visitors' perception of recreation has also received some study, although less. Ramli et al. (2018) conduct face-to-face interviews at VCs to assess users' perceptions. Eagles (2014) analyses the research priorities in PAs recreation, establishing "visitor satisfaction" as one of the most important research issues and highlighting the need to develop "theoretical structures to underpin satisfaction measurement of PAs visitor experiences" (pp. 10-11). Several authors (Moscardo et al., 2000; Pearce, 1991; Stewart, 1998) find that visitors' level of satisfaction with the recreational service at a PAs improves after visiting the VC.

The main objective of this paper is to fulfil managers' needs by designing and validating a measurement instrument to assess the level of satisfaction with VCs of PAs in Andalucía (Spain). The scope of the instrument is recreational activities delivered at the centres.

The research process has involved scientist and PA managers from the beginning. We propose a case study of thirteen VCs in PAs based on research co-designed by scientist and managers. To achieve this goal, we first developed a scale based on subjective indicators to measure users' satisfaction with services provided by VCs. Once the scale was validated, we analysed whether user perceptions are homogeneous across PAs. Finally, we established which socioeconomic variables are related to differences in satisfaction with the recreational activities at the VCs.

To this end, the study is structured as follows: Next, we perform a bibliographic review of the state of the art on scales to measure user satisfaction after an experience and their approaches to recreation in PAs. We then describe the area of study, the sampling design, and the methodology used to validate the scale. Section 4 presents the final evaluation method and results obtained for the scale's validity and reliability, as well as the results of the first application of the scale. Finally, we discuss the results, focusing on justification of the scale dimensions resulting from the study, their consistency, and application of this method for recreational management in PAs.

2. Theoretical background

Measurement of visitors' perceptions of recreation was first analysed by Crompton (1988), who studied its application in activities in a natural metropolitan area by proposing a five-dimensional model based on the measurement scale SERVQUAL (Parasuraman et al., 1988). To confirm this scale's validity, another scale was developed to measure recreation experience in PAs (Hamilton et al., 1991). These and other authors (Absher, 1998) concluded that the tool was valid but had to be adapted to each PAs network. A study by Absher for the USDA Forest Service on recreation in forest areas started from 22 items developed by a consulting firm distributed over three dimensions: facilities,

services and information. Factor analysis led to establishment of four dimensions by dividing "facilities" into two: adequacy and functioning of facilities.

A modified version of the ECOSERV scale was subsequently applied in a study at the Niah National Park in Sarawak (Said et al., 2013). Visitors' perceptions were analysed using 16 items of the six main dimensions to measure stakeholders' service experience. Finally, a study to measure service experience at campgrounds near natural lakes started from a model composed of 19 items grouped into four dimensions that explained the aspects of well-being experienced by visitors (Graefe & Burns, 2013).

One way to obtain items that determine users' perception of recreation experience is the "critical incident" technique (Flanagan, 1954). Items are obtained directly from users through interviews and/or questionnaires in which users express concrete simple ideas in negative and positive terms about aspects of the service received. Once a battery of items has been gathered, a group of experts or judges purifies and categorises them, combining and classifying the incidents into factors in an iterative process. This technique has several advantages. Most importantly, since items are gathered from the service users' perspective, they are not limited or conditioned beforehand by the researcher (Fawcett et al., 2014). The method also eliminates conditioning or initial bias as to what characteristics of the service will or will not be important (Gremler, 2004). Finally, classification of the critical incidents permits identification of determinants of the service experience defined by the customer, enabling more freedom in measuring perception of the service and preventing researchers' "blind spots" (Odekerken-Schröder et al., 2000).

One problem with these scales as tools for evaluating recreation experience is their length. There is a conflict between natural area managers' need for simple, quick-to-answer questionnaires and

researchers' need to develop validated tools to measure quality (Ryan, 2003). Burns and Graefe (2006) propose a multi-item indicator, as opposed to a simple indicator of overall evaluation. Other authors argue for developing items and dimensions that explain stakeholder perceptions through interviews in which visitors recount their positive and negative experiences from the trip (Chan & Baum, 2007). Like other authors who consider measurement of visitor perceptions of recreational experience in PAs as a complex construct that must be developed in a multidimensional way (Eagles, 2014), Lian Chan & Baum (2007) conclude that perception of recreation experience is multidimensional. Many other studies use multi-item scales to assess users' perception of recreational experience (Table 2 and Supplementary Material S3).

3. Methodology

The study was performed in two phases. The core of the study is its validation of the questionnaire. Subsequently, we used a case study to obtain and analyse information useful for decision-making.

3.1. Study location

This study was performed in 13 VCs in different types of PAs in the Andalusian Network of Natural PAs. We used a two-stage procedure to select the PAs and VCs studied. First, to cover the full diversity of natural areas, we chose PAs with different characteristics (coastal, mountain and inland lakes). We then chose specific PAs to obtain a sample heterogeneous in type and number of visitors, size of centre and services provided (Fig.1).

Questionnaire validation was performed in nine of the PAs: "Cabo de Gata", "Sierra de Cazorla", "Segura y Las Villas", "Sierra Nevada", "Sierra de Huétor", "Laguna Fuente de Piedra", "Marismas del Odiel", "Karst en Yesos de Sorbas", "Bahía de Cádiz" and "Aracena and Picos

de Aroche". We then used the questionnaire to obtain information for decision-making from the full set of PAs, adding "Despeñaperros", "Sierra de Cardeña y Montoro", "Los Villares", and "Corredor Verde del Guadiamar" to the previous group (Fig.1). The names of the VCs in each PA are listed in the Supplementary Material.

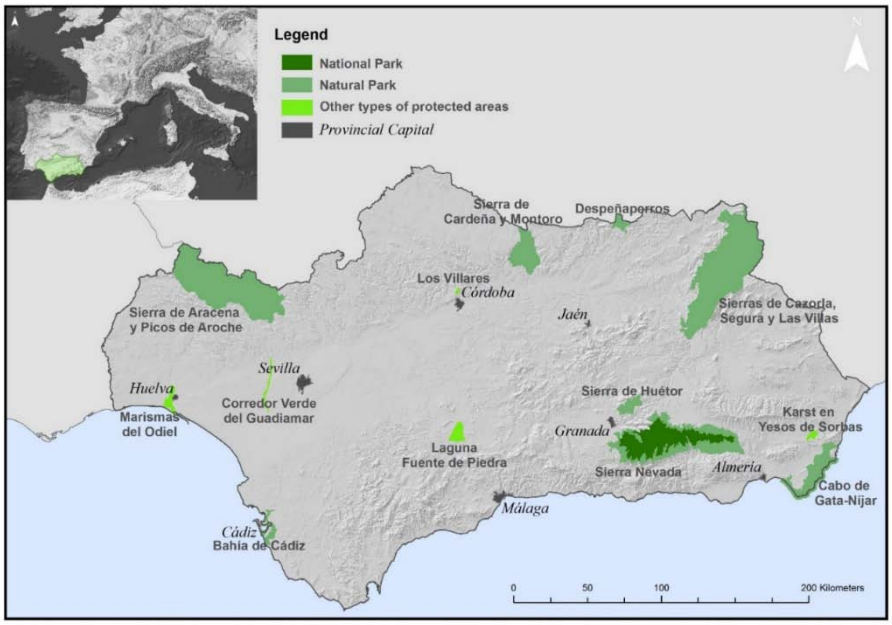

Fig.1. Region of study. PAs in map legend are presented according to their protection status. Provincial city names are in italics.

3.2. Validation of the questionnaire

We developed the study questionnaire by creating a new validated scale, following authors like Absher (1998), Graefe and Burns (2013) and Lian Chan and Baum (2007) rather than adapting existing scales such as ECOSERV or SERVQUAL. We based our decision on the advantages indicated by Fawcett et al. (2014), Gremler (2004) and Odekerken-Schröder et al. (2000), detailed in Section 1.3. We developed the scale in two steps: gathering the initial set of items and validating the questionnaire.

3.2.1. Gathering the initial items

The initial items were gathered in structured interviews and surveys to record visitors' opinions of their visit to information centres and interpretation of the natural areas. Following their visit, we asked visitors to express the positive and negative aspects of their experience. Answers were to be simple—a single idea in each sentence. A total of 147 users were interviewed. To deseasonalise responses and obtain a robust number of cases, we also reviewed 576 suggestion forms completed by visitors to these centres over an entire year.

We collected 382 critical incidents (167 positive and 215 negative items). Analysing studies that apply the critical incident technique, Gremler (2004) concludes that most (n=69, 60%) use at least 250 incidents. After establishing sufficient sample size, we grouped similar incidents under the same concept. The critical incidents were then combined at a workshop of experts (managers of natural areas, individuals in charge of use of public spaces and workers who attended users of the services at the VCs and recreation areas). This procedure generated the set of 26 internally well-differentiated items that formed part of the scale to be validated.

3.2.2. Questionnaire validation process

After obtaining the initial set of 26 items, we designed the scale validation survey (Supplementary Material). The items were phrased positively and evaluated on a seven-point Likert scale, where 1 indicated "Strongly disagree" and 7 "Strongly agree." Items were not grouped by class to avoid conditioning similar responses within the same group. The survey was anonymous to avoid desirability bias and was made available to tourists over 18 years' of age who had completed their visit to the VC. The person administering the written questionnaire explained the instructions and answered questions prior to its completion. The

sample was selected through proportional stratified sampling, with strata composed of different VCs. A total of 437 questionnaires from nine VCs in the six natural areas were collected, of which 372 were valid.

To validate the scale, we first identified the underlying dimensions in the initial set of 26 items (Supplementary Material) through exploratory factor analysis (EFA) with principal components extraction, Varimax rotation and Kaiser Normalisation. After completing the EFA, we validated the dimensions through confirmatory factor analysis (CFA). The multivariate normality test for continuous variables and PRELIS software were used to analyse normality, with the structural equations method Weighted Least Squares (WLS) (Hair et al., 2010) and LISREL 8.30 for statistical analysis. The iterative process eliminated items that did not fulfil the conditions of a t-value higher than 1.96 and a standardised solution higher than 0.4, ultimately producing the final scale.

The instrument developed to help PA managers (final scale) had to have validity, be reliable and show good fit. A measurement instrument is valid when it measures the construct for which it is designed, not a different one. Reliability is the degree to which an assessment tool produces stable and consistent results. Reliability is thus a necessary but not a sufficient condition for valid measurement. Model fit was evaluated on three levels: absolute global measures, and incremental and parsimony fit.

Validity was evaluated by reviewing the dimensions and items used in the prior scholarly literature on similar issues. We confirmed construct validity for the items through two different methods. First, the items obtained for validation of the scale included the full spectrum of issues reflected in other studies that measure visitors' perception of outdoor recreation activities connected with natural areas. Second, EFA and CFA were used to refine the dimensions of the proposed scale.

To complete the analysis, we assessed fit using absolute global measures, incremental fit and parsimony fit. After testing for individual reliability of the items, we analysed the scale's overall reliability. Accurate measurement of the construct was confirmed by measuring internal consistency of the instrument (Hair et al., 2010). We used the Alpha Cronbach indicator to evaluate internal consistency as a measure of global reliability and confirmed that this indicator did not improve when one of the items was eliminated. The values for reliability and composite variance extracted were thus appropriate.

Finally, we analysed composite reliability and variance extracted for each construct.

3.3. Questionnaire application to obtain information relevant for PA managers

Once the questionnaire was validated, it was supplemented with a set of socioeconomic variables (Appendix I). This information, combined with visitors' perception of service, was used to obtain relevant information for decision-making. To determine differences in visitors' perception between PAs, we performed Tukey's multiple comparison test. We analysed the relationship between socioeconomic variables and visitors' perception using the multivariate analysis technique Multiple Correspondence Analysis. The level of user's satisfaction with the provided services was reclassified into three categories: low, medium and high.

As in the previous case, the sample was selected through proportional stratified sampling, with strata composed of different VCs. A total of 540 questionnaires from nine VCs in the six natural areas were collected, of which 470 were valid.

4. Results

4.1. Recration management instrument

The first result of the study was a valid, reliable scale to measure users' perceptions of the services provided by VCs using the responses of stakeholders visiting visitor welcome and information centres in natural PAs. The scale had to have validity, be reliable and show good fit.

4.1.1. Content validity

The preliminary items and dimensions obtained in this study cover the full range established in the prior scholarly literature for dimensions of stakeholders' valuation of the service after enjoying it. The items thus span aspects of attention, empathy and responsibility of personnel; information; state and appearance of facilities; and ease and reliability of using the service.

The initial items included were derived from users of the service through critical incident technique. Evaluating this technique for three measures of reliability and four measures of validity, Ronan and Latham (1974) find that content validity, construct validity and relevance of critical behaviours are all satisfactory.

4.1.2. Exploratory and confirmatory factor analysis

The results show the presence of six factors. Of the 26 items, six loaded on two factors. For these cases, we associated the item with the factor with the greatest loading. The other items loaded on a single factor only (Hair et al., 2010). The first group includes nine items: v9, v10, v11, v13, v16, v20, v22, v23 and v25; the second, seven items: v5, v6, v7, v12, v14, v17 and v21; and the third, three items: v1, v4, v8 and v15. The fourth, fifth and sixth factors are composed of two items each: v24-v26, v2-v3 and v18-v19, respectively.

The results of the multivariate normality test for continuous variables show non-normality of the data (see Table 1), thus requiring use of WLS.

Asymmetry		Kurtosis		Asymmetry and kurtosis	
z-score	p-value	z-score	p-value	Chi-square	p-value
31.925	0.000	12.877	0.000	1185.031	0.000

Table 1: Multivariate normality test for continuous variables

CFA recommends eliminating one item from Factor 1 (v25), leaving eight. Factor 2 maintained all seven variables. Factor 3 lost one item (v1), leaving three variables. Factors 4, 5 and 6 were discarded due to elimination of their items. Table 2 presents the items finally validated for each dimension.

Items	λ* (t-value)	R2	Dimensions of proposed scale	Authors	α	C.R	AVE
V09 The information panels are attractive	0.81** (28.96)	0.65	Information: quantity and quality	Graefe & Burns (2013) Said et al. (2013) Crilley et al. (2012) Burns & Graefe (2006) Akama & Kieti (2003) Absher (1998)	0.826	0.981	0.855
V10 The layout of the rooms is very good	0.96** (50.20)	0.92					
V11 Information is available for visitors	0.81** (28.43)	0.66					
V13 The facilities are well lighted	0.88** (36.49)	0.78					
V16 Free maps and brochures are available	0.85** (34.98)	0.72					
V20 The information on video and panels is up to date	0.96** (69.70)	0.93					
V22 The explanatory video is of acceptable quality	0.88** (45.07)	0.77					
V23 Guides are available to give tours and explain what one is seeing	0.82** (29.81)	0.67					
V05 The signs indicating how to get there are accurate	0.84** (30.85)	0.71	Facilities	Graefe & Burns (2013) Said et al. (2013) Crilley et al. (2012) Lawton (2012) Chen et al. (2011) Crilley (2008) Akama & Kieti (2003) Ryan (2003) Absher (1998) Crompton (1991)	0.830	0.972	0.835
V06 The facilities are clean	0.87** (37.63)	0.75					
V07 The access routes are good	0.85** (34.58)	0.73					
V12 The restrooms are in good condition	0.86** (33.59)	0.75					
V14 The facilities are pleasant-looking	0.94** (43.19)	0.88					
V17 The facilities and infrastructure are well maintained	0.84** (28.64)	0.71					
V21 The access routes are in good condition	0.76** (24.51)	0.58					
V04 The service received was very good	0.73** (20.53)	0.53	Attention from personnel	Graefe & Burns, (2013) Said et al., (2013) Crilley et al. (2012) Lawton (2012) Chen et al. (2011) Crilley (2008) Burns & Graefe (2006) Akama & Kieti (2003) Absher (1998) Hamilton et al. (1991) Crompton et al. (1991)	0.829	0.903	0.757
V08 The personnel give very good information	0.84** (28.15)	0.71					
V15 People are attended quickly and efficiently	0.83** (26.14)	0.68					

Table 2. The first column presents the refined items in each dimension. The table shows the dimensions of the proposed scale and the authors who identified them in previous studies, as well as the validity and reliability indicators of both (dimensions and items). λ*=Standardised structural coefficient (t-students in parentheses); R^2=Reliability; Performance α=0 Alpha Cronbach; C.R.=Composite Reliability; AVE=Average Variance Extracted; **p<0.001.

4.1.3. Fit analysis

A non-significant statistical relationship of verisimilitude is the fundamental indicator of absolute fit. Here, the null hypothesis assumes no significant difference between the value matrices obtained and estimated. Since our sample is large, the indicator for the final three-dimensional scale is significant (X^2 370.18; 132 degrees of freedom) (Hair et al., 2010). Following recommendations in the literature (Hair et al., 2010), we thus perform other measures of fit quality with indicators less sensitive to sample size. One of these, the Goodness of Fit Index (GFI) (Table 3), ranges from 0 (worst fit) to 1 (best fit). Although no limit for affirming good fit has been established, values between 0.90 and 0.95 are advisable (Hair et al., 2010). The GFI for the scale finally proposed has a value of 0.95, indicating very good fit (Hair et al., 2010).

The scale should also have good incremental fit. We confirm increase in fit by comparing a base model and the new model. The null model, which postulates total lack of relationship among the variables, is usually used as the base model. Adjusted Goodness of Fit Index (AGFI), Normal Fit Index (NFI) and Tucker-Lewis Index (TLI) values for our scale (AGFI=0.94; NFI=0.91; TLI=0.93) are within acceptable range (0 (worst fit) to 1 (best fit)). All fulfil the recommendation of values over 0.9 (Hair et al., 2010), ensuring good fit.

Finally, to test the proposed scale's parsimony, we analyse degree of fit of the coefficients estimated for the scale. The normalised Chi-square is a valid test for confirmatory analysis. A value lower than 1 may indicate over-fit of the data, and only values lower than 3 indicate that the scale truly represents the data (Hair et al., 2010). Our scale obtained the value of 2.81 (Table 3).These tests confirm that the measures of absolute fit, incremental fit and parsimony are within the recommended range of values.

Absolute fit measures	Optimal values	Initial scale	Final scale
Degrees of freedom	Highest	286	132
Value of Chi-square and significance level	Lowest	671.62	370.18
	p<0.01	0.0	0.0
Non-centrality parameter	Lowest	385.62	238.18
Goodness of fit index	>0.9 >0.95	0.95	0.95
Standardised root mean square residual	<0.05	0.38	0.32
Expected cross-validation index	Lowest	4.43	2.12
Incremental fit measures	**Optimal values**	**Initial scale**	**Final scale**
Adjusted goodness of fit index	>0.9>0.95	0.94	0.94
Normal fit index	>0.9>0.95	0.92	0.91
Tucker-Lewis index	>0.9>0.95	0.94	0.93
Comparative fit index	>0.9>0.95	0.95	0.94
Incremental fit index	>0.9>0.95	0.95	0.94
Relative fit index	>0.9 Close to 1	0.91	0.90
Parsimony fit measures	**Optimal values**	**Initial scale**	**Final scale**
Normed Chi-square	>1 and <3<5	2.35	2.81
Parsimony goodness of fit index	Highest	0.77	0.74
Parsimony normed fit index	Highest	0.81	0.79
Akaike Information Criterion	Lowest	702.00	448.18
Critical N	>200>75	93.86	99.44

Table 3: Global validity and reliability of the scale

4.1.4. Reliability analysis

The Alpha Cronbach determines how precisely indicators measure a construct and the effect of eliminating an element from the result, enabling confirmation of whether parsimonious parametrisation is achieved in scales with very few items that contribute relevant and non-redundant information. The highest Alpha Cronbach value is 1, and values higher than 0.7 are acceptable. The Alpha Cronbach parameter is higher than 0.8 for all dimensions (Table 2) and decreases if any item is eliminated from the scale. Finally, analysis of composite reliability and extracted variance (limit values 0.7 and 0.5, respectively) shows that the conditions for both parameters are met for all dimensions.

4.2. Information relevant for PA managers

4.2.1. Visitors' valuation of the services provided in VCs

Applying the assessment questionnaire (Appendix I) at VCs in all PAs yielded dimension and item values. Overall assessment of satisfaction with the services provided was obtained from the visitors to each centre, and valuation by visitors to all VCs analysed was positive. The mean value was above 5.5 in all VCs, and 62% obtained mean values above 6 (Fig. 2). VC 2 showed a high percentage of scores of 7 (85.3%), and in 62% of VCs, the values were greater than or equal to 5. In all centres, scores of 5, 6 or 7 accounted for at least 85% of the total. These results suggest that the value visitors assign is not only high but homogeneous across all PAs.

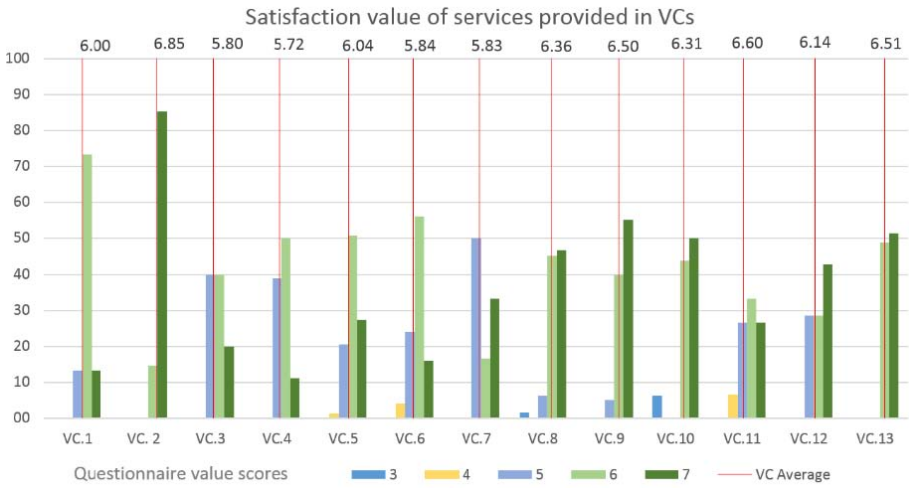

Fig. 2. Satisfaction value of services provided in the VCs. Bars shows percentage of score received by each VC that composes the global value. Red lines and their labels represent mean valuation. VC names are provided in the Supplementary Material.

4.2.2. Differences in visitors' valuation of services provided across VCs

Table 4 presents the results of Tukey's multiple comparison test for the cases in which visitors' valuation differed significantly between centres. In 86% of the cases, users' perception of the VC at PAs showed no significant differences. Note that VC 2 has better perception values than VCs 1, 4, 5, 6, 7 and 11. Further, valuation of VC 1 improves the results of VCs 4, 6 and 11. Finally, VC 11 shows worse results than four other centres (VCs 2, 8, 9 and 11).

VC comparison	Differences	Lowest point	Highest point	Adjusted p
2-1	0.853	0.095	1.611	0.013
2-4	1.131	0.418	1.844	0.000
2-5	0.812	0.304	1.320	0.000
2-6	1.013	0.368	1.658	0.000
2-7	1.020	0.198	1.841	0.003
2-11	1.253	0.495	2.011	0.000
8-11	0.759	0.058	1.461	0.021
9-11	0.900	0.064	1.736	0.022
13-4	0.790	0.098	1.482	0.010
13-6	0.672	0.051	1.293	0.021
13-11	0.912	0.174	1.650	0.003

Table 4: Tukey's multiple comparisons of means. 95% family-wise confidence level. Differences: difference in observed means. Lower point: lower endpoint of interval; Upper point: upper endpoint of interval; adjusted p: value after adjusting for multiple comparisons. The differences were significant in 11 of 78 pair wise comparisons.

4.2.3. Influence of socioeconomic variables on visitors' valuation

The socioeconomic variables analysed were income level, employment status, education level and NGO membership (Fig. 3)—all categorical variables (see descriptive statistics of people interviewed in Supplementary Material). Most but not all of these variable categories correspond to high valuation by visitors. People without education

tend to assign a low valuation level. People with no income or higher incomes (over 3000€/month) usually assign similar, intermediate values. Students tend to express medium-level satisfaction with the services provided.

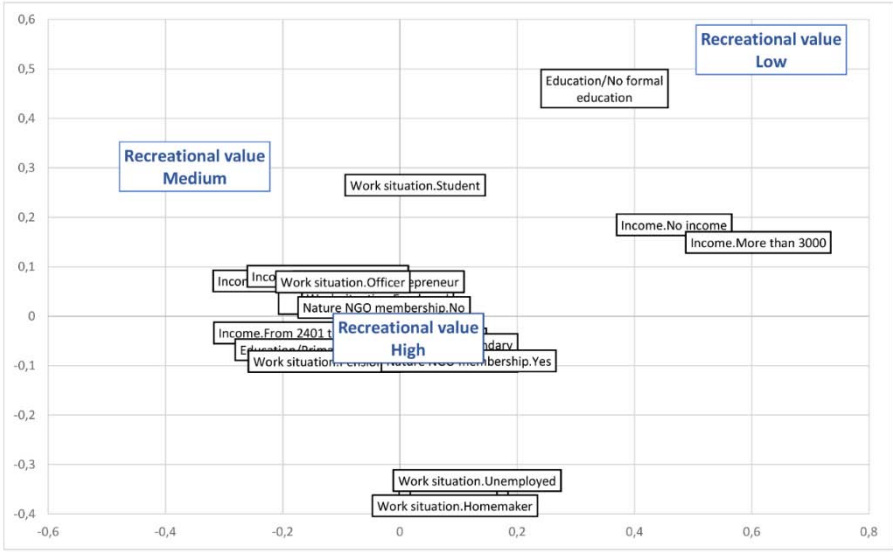

Fig. 3. Multiple correspondence analysis showing influence of socioeconomic variables on user satisfaction with services provided by VCs (Recreational value).

5. Discussion

5.1. Method to guide decision-making in PA VCs

The scale proposed in this study constitutes a valuable instrument for measuring users' satisfaction with the services provided by VCs in a PA network. First, the scale makes an important theoretical contribution. Each facet of the scale has high validity, and the scale's content validity has been contrasted and verified relative to similar studies in the field, in both dimensions and items (Absher, 1998; Chen et al., 2011; Crilley, 2008; Crilley et al., 2012; Crompton et al., 1991; Graefe & Burns, 2013, among others). The study also reviews scholarly knowledge to date on

PA visitor valuation of experience of recreational activities. Another important contribution is its obtaining of the initial items through the critical incident technique (Flanagan, 1954) employed to design one of the scales most used in measuring service perception by users, SERVQUAL (Parasuraman et al., 1988). Although the technique has been widely validated in research on perception of service experience (Gremler, 2004), this is the first time it has been applied to design a method to guide decision-making in PA VCs. Items are thus collected from the perspective of the visitors and not limited or preconditioned by the researcher (Fawcett et al., 2014).

The study establishes three dimensions to assess visitors' valuation of the services provided in the VCs: information, facilities and service received from personnel. The first dimension is composed of eight items (Table 2), all of which refer to presence and quality of information available to visitors through questions on information available to the public, availability of maps and informational brochures, and interpretive guides who give information in person. We also evaluated quality of information panels and explanatory videos, and layout and lighting of information rooms in the centre (common denominator is quantity and quality of information provided to visitors to the natural PA). This dimension appears in recent studies in the field of recreation research (Crilley et al., 2012; Graefe & Burns, 2013) and in earlier studies (Absher, 1998; Burns & Graefe, 2006). Other studies that adapt the ECOSERV (Said et al., 2013) or SERQUAL (Akama & Kieti, 2003) scales include items clearly linked to this study's dimension "information". These items refer to whether employees have sufficient knowledge to give accurate information and whether the information about the natural area is relevant and attractive.

The second dimension that the study produces combines seven items related to the facilities where service is provided. The elements composing this dimension refer to whether the facilities are clean, and whether facilities and access routes are in good condition. All

previous studies include infrastructures in their scales. Ryan (2003) uses two dimensions for this concept: infrastructures and ancillary infrastructures. Other authors include infrastructure in the dimension tangibles—for example, Crompton (1991), Akama (2003) and Said et al. (2013) establish ecotangible and tangible dimensions. Other authors, such as Chen et al. (2011), include this concept in the dimensions physical environment and technical quality. Crilley (2008) establishes the factor aesthetics and Absher (1998) the dimension facility-sufficiency. Other recent studies (Crilley et al., 2012; Graefe & Burns, 2013; Lawton, 2012) also use both dimensions and many items that measure state and quality of infrastructure. The third factor found encompasses three items to measure service the visitor receives from PA personnel. This factor evaluates courtesy of personnel and service received from them, and is prominent in all studies to date, primarily in the dimensions "Service" (Absher, 1998; Crilley et al., 2012; Graefe & Burns, 2013) and "Responsiveness and Empathy" (Akama, 2003; Crompton, 1991; Hamilton et al., 1991; Said et al., 2013).

Secondly, the scale makes a valuable contribution from the practical point of view, as it is adapted to recreational management at VCs in PAs. The questionnaire design fulfils a need among managers in the PA network (Ryan & Cessford, 2003) by providing a simple, functional way to measure experience opinions concerning services and facilities after enjoying activities at VCs. The instrument is composed of a small number of items (compared to other scales) and is easy to answer (uses a seven-point Likert scale), as this study proves. Managers can thus apply it directly. Another contribution of the instrument is its potential to implement a long-term system to monitor value of recreational visitor centres and socioeconomic characterisation of stakeholders. A data set for several years would not only inform managers of the evolution of value but also provide feedback on the success or failure of their management actions.

5.2. Relevant information for PA managers

PA managers derive useful information from this questionnaire. First and most obvious is the high value of stakeholders' satisfaction with recreational experience at all centres (higher than 5 out of 7 in all VCs). Only three of the centres studied received scores below 4, and in all cases those responses constituted less than 10% of the total. In 62% of the VCs, values of 5, 6 and 7 constituted 100% of all scores, and scores of 5-7 represented at least 85% of the total for all VCs. From the managers' perspective, this is a great result for the entire PA network, due not only to the visitors' positive perception but also to the apparent homogeneity of value throughout the network.

We performed Tukey's multiple comparisons test to determine whether the differences in visitors' valuation between VCs were significant. In most cases (86% of pairwise comparisons), there were no significant differences in visitors' satisfaction between VCs. These results confirm high homogeneity of value throughout the network. This is a very important issue for managers of the recreational service, because they are worried to maintain a good level of service in all their centres. Our method allows monitoring homogeneity trough time across the network. However, VCs 2 and 13 obtained higher visitor valuation than others (VCs 1,4,5,6,7,11 and VCs 4,6,11 respectively) in a pairwise comparison. On the other hand VC 11 obtained significantly lower results than VCs 2,8,9 and 13. These results are very interesting for both, the local managers of the centres and the chief of the andalusian service of the network of protected areas. Not only by knowing the centres, but by detecting the causes of success or failure. They can detect which centres are better or worse valued by the visitors and investigate the reasons that explain the values. The questionnaire data may help them to apply the causes of success in the most valued centres to those who need to improve. Also detecting the reasons for worse valuations is useful to avoided those mistakes in other centres.

Finally, sociocultural factors may explain perceptions and values assigned to recreational activities (Maestre-Andrés et al., 2016). Our measurement instrument enabled managers to identify what sociocultural variables influence visitors' valuation of VCs. The results suggest some unexpected conclusions. Although we expected members of environmentally conscious NGOs to evaluate recreational activities higher than non-member visitors, the multiple correspondence analysis shows no differences between these groups. This finding implies that promoting environmental organisation membership is not the way to get people to value recreation at a VC. Environmental organisations clearly have many social benefits, but not this one. It is important for managers to note, however, that people without education tend to attribute lower values to their experience in VCs. Positive evaluation of the environmental activities in the centres is linked to better knowledge of environmental values. This result is in line with Zoderer et al. (2016), who conclude that cultural background is an important driver of perceived importance of cultural services. Such findings emphasise to environmental managers the need to improve and promote environmental education and knowledge of the value of their PAs.

Other stakeholder profiles tend to assign recreational experience intermediate values—people with no income or high incomes (over 3000€/month). Visitors with no income tend to value the visit to VCs less than do other economic profiles. Along these lines, Martinez-Harms et al. (2018) highlight that people in lower-income areas have less access to the benefits of nature. This finding may explain our result, as low income is usually related to low level of culture. Maybe lack of economic capacity to access PAs results in less environmental knowledge, again highlighting the need to increase environmental knowledge in order to improve society's enjoyment and valuation of the benefits of nature. Lower valuation by high-income visitors may be explained by several factors. People with this profile may have low environmental interest or seek more complex environmental activities. Despite a high level of income, they may not have enough knowledge to

value the information and activities at VCs. Managers found this result as an unexpected outcomes. However, to explain in a deep way the reasons will require the inclusion of more variables in the study. So, it would be interesting to explore this issue in further research. Finally, young people who are students tend to assign intermediate scores. This group has not yet completed higher education, and previous results suggest that higher education may improves people's knowledge of ecosystems and valuation of ecosystem services and related activities at VCs.

Despite common practice in the business sector, many areas of public management have not characterised users of a service. The measurement instrument designed here allows managers not only to improve their knowledge of recreational visitors but also to relate specific types of visitors to valuation of recreational activities. This information could guide managers' decisions on such issues as environmental education, recreational activities and promotional actions oriented to a specific type of user.

6. Conclusions

This study is the result of collaboration between scientists and managers that incorporates stakeholder engagement. The core product is an instrument to measure visitors' valuation of recreational activities after their experience at VCs of PAs in Andalusia (Spain). The resulting scale fulfils both the management's requirements and the conditions of validity and reliability required of a good measurement scale. The questionnaire developed is simple and functional, guaranteeing generation of a useful and directly applicable measurement tool. This method can either be used directly or adapted to recreation management in other PAs with similar organisation and government models. The methodology to develop a new measurement instrument can also be applied easily to assess recreation services at facilities in PAs.

The values obtained from the first application of the scale produced useful results for managers' decision-making process. In addition, the instrument provided managers with information useful for decision-making related to differences in visitors' valuation of recreational activities among centres throughout the PA network and socioeconomic factors that may explain perceptions and values assigned by visitors in the case study. However, investigation of factors that explain some of the relationship between visitors satisfaction and socioeconomic variables, will require the inclusion of more variables in the study. So, further researches are needed to explore this issue.

Yet all of this information is merely a snapshot of the recreational management status at VCs. One advantage of the measurement instrument is its potential for obtaining a long-term data series. There is increasing agreement on the need for a large-scale assessment methods (Bryce et al., 2016) to enable managers to measure not only feedback on recreational management at a given time but also changes over time and the relationship of sociocultural variables to these changes.

Finally, this study is based on solving a management problem using a scientific methodology. As knowledge co-production (between managers and scientists) ensures that managers can apply the management instrument developed (final questionnaire) directly, this study advances development of a method of collaborative research by scientist and practitioners to improve recreational management in PAs.

Acknowledgements

We appreciate the collaboration of visitors to the natural PAs who took time to fill out the questionnaires and provide their opinions. We also thank the Andalusian Department of the Environment (Consejería de Medio Ambiente) and the staff of the VCs, who helped with this research by distributing and collecting the questionnaires.

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Supplementary material

Supplement S1: VC´s name in each protected area

Visitor Center (VC)	Visitor Center Name	Protected Area
1	“Cabildo Viejo”	“Sierra de Aracena y Picos de Aroche” Natural Park
2	“Bahía de Cádiz”	“Bahía de Cádiz” Natural Park
3	“Las Amoladeras”	“Cabo de Gata-Níjar” Natural Park
4	“Venta Nueva”	“Sierra de Cardeña y Montoro” Natural Park
5	“Río Borosa”	“Sierras de Cazorla, Segura y Las Villas Natural Park
6	“Guadiamar”	“Corredor Verde del Guadiamar” Protected Landscape
7	“Llanos de las Américas”	“Despeñaperros” Natural Park
8	“José Antonio Valverde”	“Laguna de Fuente de Piedra” Natural Reserve
9	“Puerto Lobo”	“Sierra de Huétor” Natural Park
10	“Los Villares”	“Los Villares” Periurban Park
11	“Anastasio Senra”	“Marismas del Odiel” Natural Park
12	“Dornajo”	“Sierra Nevada” National and Natural Park
13	“Los Yesares“	“Karst en Yesos de Sorbas” Natural Park

Supplement S2: Initial set of items obtained using the critical incident technique

V01	The personnel are courteous.
V02	The information about nature is attractive.
V03	The models are very attractive.
V04	The service received was very good.
V05	The signs indicating how to get there are accurate.
V06	The installations are clean.
V07	The access routes are good.
V08	The personnel give very good information.
V09	The information panels are attractive.
V10	The layout of the rooms is very good.
V11	Information is available for visitors.
V12	The restrooms are in good condition.
V13	The installations are well lighted.
V14	The installations are pleasant-looking.
V15	People are attended quickly and efficiently.
V16	Free maps and brochures are available.
V17	The installations and infrastructures are well maintained.
V18	Information is insufficient.
V19	The centre is a comfortable temperature.
V20	The information on the video and panels is up-to-date.
V21	The access routes are in good condition.
V22	The explanatory video is of acceptable quality.
V23	Guides are available to give tours and explain what one is seeing.
V24	There are objects and information on local customs.
V25	The centre provides a variety of activities.
V26	There are detailed topographical maps with information on routes.

Supplement S3: Dimensions used to measure recreation service by the stakeholders

Dimensions of the proposed scale	Authors	Related dimensions
Information: quantity and quality	Graefe &Burns (2013)	Information
	Said et al. (2013)	Assurance
	Crilley et al. (2012)	Information
	Burns & Graefe (2006)	Information
	Akama & Kieti (2003)	Assurance Responsibilities
	Absher (1998)	Information
Installations	Graefe & Burns (2013)	Facilities
	Said et al. (2013)	Ecotangibles Tangibles
	Crilley et al. (2012)	Nine items
	Lawton (2012)	Four items
	Chen et al. (2011)	Physical environment Technical quality
	Crilley (2008)	Aesthetics
	Akama & Kieti (2003)	Tangibles
	Ryan (2003)	Infrastructure Ancillary infrastructure
	Absher (1998)	Facility-Sufficiency
	Crompton (1991)	Tangibles
Attention from personnel	Graefe & Burns, (2013)	Service
	Said et al., (2013)	Responsiveness and empathy
	Crilley et al. (2012)	Service
	Lawton (2012)	1-item scale with the single construct Visitor satisfaction
	Chen et al. (2011)	Personal interaction
	Crilley(2008)	Staffing
	Burns & Graefe (2006)	Responsiveness of staff
	Akama &Kieti (2003)	Responsibilities Reliability Assurance
	Absher (1998)	Service
	Hamilton et al. (1991)	Responsiveness and empathy
	Crompton et al. (1991)	Responsiveness and empathy

Supplement S4: Descriptive statistics of interviewed people

Variable				Variable			
	Categories	N	Percentage		Categories	N	Percentage
Age	Under 30 years old	111	23,6	Marital status	Single	172	36,6
	30-45 years old	165	35,1		Married	207	44,0
	45-65 years old	110	23,4		Divorced	39	8,3
	Over 65 years old	36	7,7		Widow/ Widower	28	6,0
	NA	48	10,2		NA	24	5,1
	Total	470	100		Total	470	100
Income	No income	41	8,7	Education	No formal education	29	6,2
	Up to 600	51	10,9		Primary school	38	8,1
	From 601 to 1200	103	21,9		Secondary education	118	25,1
	From 1201 to 1800	98	20,9		Undergraduate degree	107	22,8
	From 1801 to 2400	63	13,4		Degree	154	32,8
	From 2401 to 3000	26	5,5		Others	24	5,1
	More than 3000	24	5,1		NA	29	6,2
	NA	64	13,6		Total	470	100
	Total	470	100				
Nature NGO membership	Yes	77	16,4	Work situation	Employed	152	32,3
	No	360	76,6		Entrepreneur	60	12,8
	NA	33	7,0		Officer	39	8,3
	Total	470	100		Self-employed	44	9,4
					Unemployed	38	8,1
					Homemaker	42	8,9
					Student	31	6,6
					Pensioner	25	5,3
					Other	13	2,8
					NA	26	5,5
					Total	470	100

Appendix I: Validated questionnaire

The University of Granada and the Andalusian Department of the Environment are performing a study to analyse valuation of the recreation ecosystem service in visitor reception centres in protected areas in Andalusia. Thank you for your collaboration.

On a scale of 1 to 7, please indicate your degree of agreement with the following statements: **(1 strongly disagree; 7 strongly agree; DK/NA=Don't know/No answer)** (*The respondent must evaluate all of the statements.*)

a) The explanatory media (panels, models, reproductions, interactive displays...) are attractive.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

b) The layout of the rooms is very good.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

c) Information is available for visitors.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

d) The facilities are well lighted.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

e) Free informative maps and brochures are available.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

f) The information on video and panels is up to date.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

g) The audio-visuals are of acceptable quality.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

h) Guides are available to give tours and explain what one is seeing.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

i) The signs indicating how to get there are accurate.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

j) The facilities are clean.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

k) The access routes are good.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

l) The restrooms are in good condition.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

m) The facilities are pleasant-looking.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

n) The facilities and infrastructures are well maintained.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

o) The access routes are in very good condition.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

p) The service received was very good.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

q) The personnel give very good information.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

r) The service received was quick and efficient.
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ DK/NA

In general, please rate your satisfaction with the activities performed in the visitor centre from 1 to 7:

(1 strongly disagree; and 7 strongly agree)
☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

Finally, we would like to ask you some questions. Remember that this questionnaire is anonymous:

1. *Year of birth:*

2. *Marital status:*
☐ single ☐ married ☐ divorced ☐ widowed

3. *Do you have children?*
☐ yes ☐ no

4. *Education:*
☐ no formal education ☐primary school
☐ secondary school ☐ vocational training
☐college ☐ other (specify)

5. *Occupation:*
☐ employed/salaried
☐ business owner/self-employed
☐ civil servant ☐independent professional
☐ unemployed ☐homemaker
☐ student ☐ retired ☐ other, specify

6. *Are you a member of any association for protection of the environment?*
☐ yes ☐ no

7. *Does your average net monthly family income fall within any of these ranges?*

No income	
Up to **600 euros**	
601-1200 euros	
1201-1800 euros	
1801-2400 euros	
2401-3000 euros	
Over **3001 euros**	
Don't know	


SIERRA DE HUETOR

Chapter 5

Economic and subjective valuation of recreation ecosystem services to improve management decisions in protected areas

Moreno-Llorca Ricardo A, García-Morales, Víctor J, Ramos-Ridao Ángel F. 2022.

Abstract

Operationalising the cultural ecosystem services framework for decision support in protected area management remains a challenge. This study addresses the question asked by both scholars and managers: how to value and improve the recreational ecosystem services provided in protected area visitor centres. It does so by combining methods for valuing ecosystem services economically (willingness to pay) and through subjective indicators (recreational service quality perception scale). The results identify an economic value for the fee to visit the centre and value the quality visitors perceive while enjoying the ecosystem service. Joint analysis of both of these results gives managers information on how to improve management of their centres by enabling them to define specific variables that will increase users' valuation of the service. It also enables managers to identify the levels of perceived quality for which users are willing or unwilling to pay a specific amount to visit the centre. Combining methods for valuing recreational ecosystem services is a good way to operationalise the concept of ecosystem services in real protected area management issues.

Keywords

recreational ecosystem services; willingness to pay; service quality perception; decision-making support; protected areas; visitor centres

1. Introduction

Ecosystem services (ES) are benefits that society obtains from nature (Millennium Ecosystem Assessment, 2005; United Nations et al., 2021). The scientific literature generally distinguishes between provisioning, regulating and cultural services (Haines-Young and Potschin, 2018). Cultural ecosystem services (CES) are non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (Millennium Ecosystem Assessment, 2005). Recreational nature-based experiences that protected areas (PAs) provide to visitors and tourists are outstanding CES (Kim et al., 2019).

From the visitor's point of view, CES produce beneficial effects because enjoyment of recreational ecosystem services (RES) has a positive effect on subjective well-being (Bryce et al., 2016; Millennium Ecosystem Assessment, 2005). From a management perspective, an increase in public visits due to nature-based tourism may significantly impact management of PAs (Kim et al., 2019). Visitor experience analysis has been identified as critical for sustainable management of recreation (Moyle et al., 2017). From a social perspective, direct or indirect revenue derived from recreation and ecotourism could ensure sustainability of the population's economic and social progress in PAs. Income from recreation can increase over time, as recreation is one of the highest-growth economic sectors in tourism (Barros et al., 2015; Buckley, 2009; Hindsley et al., 2011; Rolfe and Dyack, 2019).

The concept of ES is underused in practical decisions concerning conservation/development plans and programs (Tardieu and Tuffery, 2019). One reason for its underuse may be that the ES framework asks questions irrelevant to real-world applications, generating data that do not serve real-world applications (Root-Bernstein and Jaksic, 2017). Moreover, the intangibility of CES produces a gap in decision-making tools for managing these services in PAs. Enquist et al. (2017),

for example, indicate that scientists and managers must work together from the start to establish the questions and methodologies to be used to ensure effective implementation of the results. The broad scientific community has thus attempted to achieve consensus in valuation of recreation services to inform PA managers on recreation (Hermes et al., 2018; Rolfe and Dyack, 2019) through both monetary and non-monetary methods.

Monetary valuation of ES is a promising approach to highlighting ES' relevance to society and the economy. It helps to develop cost-effective policy instruments for nature management and perform impact assessments in cost-benefit analysis. Monetary valuation may also be useful in establishing fees for ES (Liekens et al., 2013). Some ES valuation methods that provide exchange values are based on production cost function, replacement cost, hedonic pricing, residual resource income or simulated exchange values (SEVs) (Caparrós et al., 2017). Extensive research has been performed on economic valuation of recreation services. Several studies use travel cost methods to assess value (Ezebilo, 2016; Mayer and Woltering, 2018; Zin et al., 2019). Contingent valuation (Satari Yuzbashkandi and Mehrjo, 2019) or a mix of both approaches are also widely used (Rolfe and Dyack, 2019). Other studies are based on monetary assessment of RES through choice experiment (Carson et al., 2015; Thiene et al., 2017), visitor expenditure (Hjerpe, 2018; Schirpke et al., 2018) or SEVs (Caparrós et al., 2017).

Non-monetary valuation of RES, in contrast, provides insights to improve understanding of other dimensions of ES value, as well as of driving factors behind economic value attributed. Defined as the nonmaterial benefits people obtain from ecosystems through recreation (Millennium Ecosystem Assessment, 2005), RES are especially difficult to operationalise due to their intangibility (Milcu et al., 2013). Sociocultural valuation of ES is needed, however, to improve PA management (Maestre-Andrés et al., 2016). As with valuation of other CES, it requires conceptualising and operationalising visitors' valuation of RES based on how visitors perceive and express in their

own words their valuations of their experiences in natural environments (Stålhammar and Pedersen, 2017).

Several studies have analysed the relationship between enjoyment of RES and human well-being. Saad et al. (2019), for example, demonstrated that physical activities in a forest area could enhance health benefits by reducing visitors' psychological stress level. The strongest factor explaining human well-being is enjoyment of and interaction with nature, represented by indicators of learning about nature, connecting with nature and feeling one is caring for nature, among other activities (Bryce et al., 2016; Castellanos-Verdugo et al., 2016). Similarly, Sangchoey et al. (2020) found that recreational and environmental education activities, such as those in which people participate at the visitor centres (VCs) studied here, correlate with better visitor behaviour and respect for the protected natural area. Making more visits to nature is also related to better health. Moreover, the number of visits is likely to increase if specific natural areas attributes are provided, particularly visitor facilities such as VCs (Grilli et al., 2020).

Others studies have focused on visitors' perceptions in terms of level of satisfaction with recreational experiences in PAs. Adapting the SERVQUAL measurement instrument to ecotourism services to analyse the underlying factors of ecotourists' satisfaction, Yusof et al. (2014) concluded the need to adapt quality scales on a case-by-case basis. Following this advice, Moreno-Llorca et al. (2019) co-designed a scale constructed from scratch (based on critical incidents technique) to measure the satisfaction of people obtaining recreational services in the VCs in natural areas. The results of these studies help VC managers to improve services and facilities designed to provide recreational activity for visitors, increasing the perceived value of the RES (Castellano-Verdugo et al., 2016).

Several research findings have analysed visitors' perceptions to understand visitors' profiles (Booth et al., 2010) and relationship to the

most-appreciated characteristics of the recreational services enjoyed in the PAs. Kil et al. (2015) examined differences in experiential benefits sought, place meanings and environmental setting preferences between proximate and distant visitors to improve effective management of recreation. Similarly, Kainzinger et al. (2016) explored different visitor profiles and preferences to manage RES in a river environment. Agyeman et al. (2019) analysed the influence of sociocultural variables on perceived and preferred RES, providing information useful for designing and managing recreational offerings in natural areas. The authors found that age and frequency of visit had little or no influence, gender and education level were somewhat influential, and income and education level were determining factors of visitors' RES valuation. Moreno-Llorca et al. (2019) also found that income and education level were determining factors in people's perception of RES enjoyment at VCs. Furthermore, the factors "being with family", "viewing natural scenery" and "enjoying the smells and sounds of nature" (Sonter et al., 2016) were all highly important motivations to visit natural areas.

Another body of research has analysed visitors' preferences for recreational activities from a spatial perspective. This research investigates the features of environment and landscape that increase RES' value (Sonter et al., 2016) or influence visitors' choice of recreation site (De Valck et al., 2017; Oleson et al., 2020; Vaz et al., 2020). Other studies performed explicitly spatial analysis of the joint effect of ecological and social factors to quantify recreation supply and demand to support political strategies (Peña et al., 2015).

Finally, built infrastructures (Heagney et al., 2018), as well as visitor service facilities (e.g., VCs), are strongly related to demand for RES (Grilli et al., 2020; Heagney et al., 2018). As improvement and upgrading of VCs increases visitors' perceived value of RES (Paltriguera et al., 2018), managers are very interested in understanding the key factors that make their centres more valuable.

Despite efforts to transfer scientific knowledge to RES management, the informal nature of recreation makes it difficult to determine extent of activity, the value attached to it, and how to operationalise it to help managers. Recreation in natural areas comes under the jurisdiction of several public agencies, but none provides a full picture of the value of either recreation derived from natural ecosystems or the value at risk when other developments change those ES (Clough, 2013). The best way to generate useful knowledge for managers is thus to focus on the specific problems managers or their management sphere face—in this case, VCs in the PAs.

This study addresses a question concerning recreational management in the network of PAs in Andalusia (Spain) based on the joint work of scientists and managers: how are the recreational services provided in the VCs of PAs valued, and how can they be improved?

To answer this question, we propose mixed monetary and non-monetary valuation (Daams et al., 2019). First, we estimate economic value as willingness to pay (WTP) a potential fee to visit the PA's information centre through a stated preference model. Second, we measure perceived value using subjective indicators from the scale developed by Moreno-Llorca et al. (2019). We thus explore the influence of visitors' perceptions on WTP (Faccioli et al., 2020).

More specifically, we aim to answer the following questions:

- What is the value of the recreational services provided at the VCs in Andalusia's natural parks?
- Should different entrance fees be charged if we consider maximum availability to pay?
- Does the value of recreational services provided at the VCs differ based on different perceptions of quality?
- What quality perception variables explain greater WTP?

2. Material and Methods

2.1 Study location

This study was performed in twelve VCs in the Andalusian Network of Natural Protected Areas (RENPA, Spain). Nine PAs and VCs were chosen to cover the full range of natural areas and variety of habitats (coastal, mountain and inland lakes). Three additional PAs were added to obtain a sample heterogeneous in type and number of visitors, size and services provided (Fig. 1). The names of the VCs in each PA are listed in the Supplementary Material (Supplement S1).

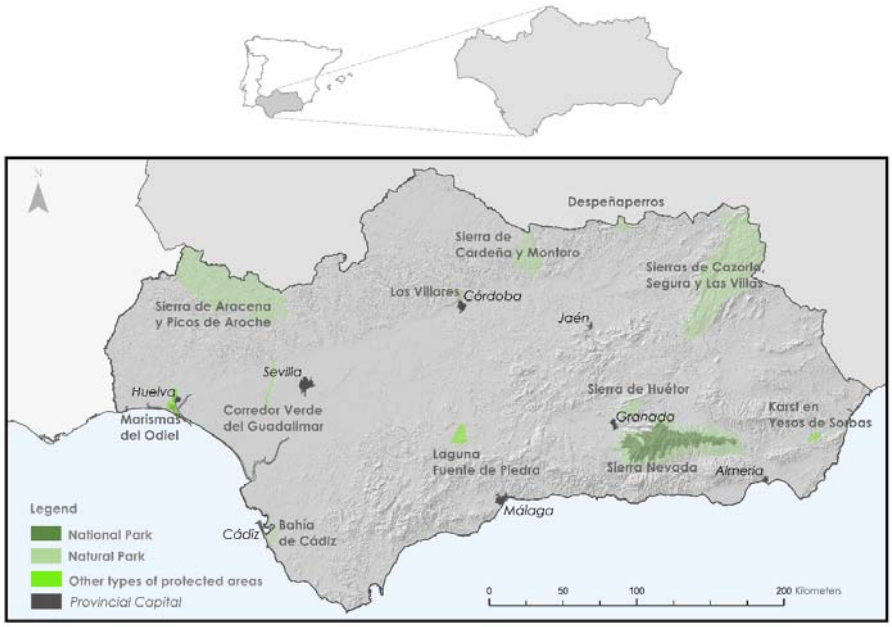


Fig.1. Region of study. PAs presented based on their protection status. Provincial city names are in italics.

2.2 Data collection and survey design

The sample was selected using proportional stratified sampling, with strata composed of different VCs. Calculations were based on attendance

statistics for each nature centre for the past five years. A total of 570 questionnaires were collected from 12 VCs in the natural areas, of which 49 were considered as protest responses and 29 as incomplete or inaccurate responses, resulting in a total of 492 valid questionnaires.

The survey was designed to collect information on three different issues. First, it assessed visitors' perceptions of the RES, based on the scale developed by Moreno-Llorca et al. (2019). The items were evaluated on a 7-point Likert scale, where 1 signified "Strongly disagree" and 7 "Strongly agree". Items were worded positively and randomly placed to avoid similar responses in the indicators belonging to the same perceptual dimension. A global satisfaction item was added at the end of the scale. Second, the questionnaire asked about economic valuation of the visit to the Recreation Service Centre. Each questionnaire asked about WTP, not a specific amount of money (1, 2, 5 and 12€). The visitors were then asked the maximum amount of money they were willing to pay. If they were not willing to pay anything to enter the VC, they were asked for their reason, to detect protest responses. Finally, the questionnaire gathered socioeconomic data.

The interviews were performed face-to-face with Recreation Service Centre visitors and conducted from June 2018 to April 2019. The questionnaire was anonymous, and protest responses were detected and removed to avoid desirability bias. The questionnaires were provided to tourists over 18 years of age who had completed their visit to the centres. The person administering the questionnaire explained the instructions and answered questions prior to its completion.

2.3 Recreational Ecosystem Service Valuation

The first method for estimating the hypothetical economic fee visitors will pay to access the VCs is based on the question about WTP, measured as a concrete amount recorded after the visit. The answers formed the basis of an estimated logit model of stated preferences. WTP an entry

fee to the VC was determined following the method in Krinsky and Robb (1990). We used a logit parametric regression to calculate WTP, with yes or no responses to several prices (1, 2, 5 and 12 €).

In addition to the average WTP, we also report the SEV and the associated price (Caparrós et al., 2003, 2017). Following Caparrós et al. (2017), we assumed a fixed cost for providing the service. To obtain the SEV, we thus need only find the value that maximises revenue. Revenue maximisation was not calculated based on the logit model, but rather on the responses for maximum WTP—that is, the responses of visitors who said they were not willing to pay a specific amount (1, 2, 5 or 12€) but were willing to pay a lower amount they chose to pay freely. Based on these values, we calculated total revenue for each entry fee by counting all respondents willing to pay that amount or more (Table 2).

2.4 Relationship between perceived quality and WTP

We analysed the number of visitors willing to pay an entry fee to access the VC, classified by perceived quality values using descriptive analysis. This analysis represents the relationship between perceived quality and WTP visually.

We also analysed which quality variables were related to WTP using a hypothesis test of means. For each variable analysed, we hypothesised that the mean of those not willing to pay is lower than the mean of those willing to pay for admission.

Finally, a bivariate logit model measured the benefit factor, or how much WTP increases as perception of quality increases (e.g., how much the percentage of people willing to pay increases for VCs with a perceived quality of 7 versus 6). This model presents the response variable as dependent variable, and price and different values of perceived quality as explanatory variables.

3. Results

3.1 Valuation of recreation ecosystem service through willingness to pay

Based on the question about WTP, the hypothetical economic value to access to the VCs estimated was 3.27 Euros. The confidence interval at 5% was 2.9 – 3.7 Euros.

The model shows good fit ($p<0.001$), and the variable price explains WTP (Table 1).

	Estimate	Std. Error	z value	p-value
Intercept	1.87170	0.20512	9.125	<2e-16
Price	-0.57254	0.06069	-9.434	<2e-16

Table 1. Model fit values ($p< 0.001$).

The entry fee was estimated based on the question about maximum WTP to determine which entrance fee would maximise net revenue, assuming zero variable costs and monopoly or monopolistic competition in the short run (Caparrós et al., 2017). In our case, a ticket priced at 2 Euros would yield the highest total revenue, 618 Euros (Table 2).

Fee (€)	1	2	3	4	5	6	8	10	12	15
Total incomes (€)	418	618	540	336	375	150	136	120	72	30

Table 2. Optimal price according to the maximum amount visitors are willing to pay.

3.2 Relationship between perceived quality and WTP

All visitors who rates perceived quality level from 1 to 3 refused to pay any entrance fee to access and experience the VC (Fig. 2). Of the visitors who perceived a quality level of 4, 11% were willing to pay to access the centre. This percentage rose to 34% for visitors who rated quality as 5, to 46% for ratings of 6 and to 49% for a quality ratings of 7.

The results thus demonstrate a relationship between perceived quality and WTP to visit the centre.

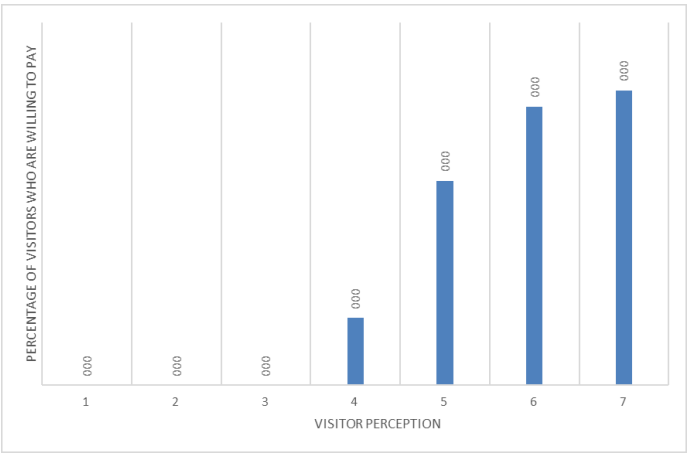


Fig. 2. Percentage of visitors willing to pay for a visit, according perceived quality values.

The hypothesis contrast identified the quality variables most closely related to WTP admission fees. The most closely related variable was cleanliness of the facilities, followed by exhibition media, quality of access, layout of environmental education rooms and attention of the staff, among other factors (Table 3).

		p. value
P10	The facilities are clean	0,0013
P1	The information panels are attractive	0,0021
P15	The access routes are good	0,0026
P2	The layout of the rooms is very good	0,0037
P19	People are attended quickly and efficiently	0,0047
P12	The signs indicating how to get there are accurate	0,0173
P4	The facilities are well lighted	0,0188
P6	The information on video and panels is up to date	0,0309
P7	The explanatory video is of acceptable quality	0,0373
P11	The facilities are pleasant-looking	0,0424
P3	Free maps and brochures are available	0,0488
P13	The restrooms are in good condition	0,0490

Table 3. Quality variables related to WTP, in order of importance from lowest to highest p-value (Student's t-Test).

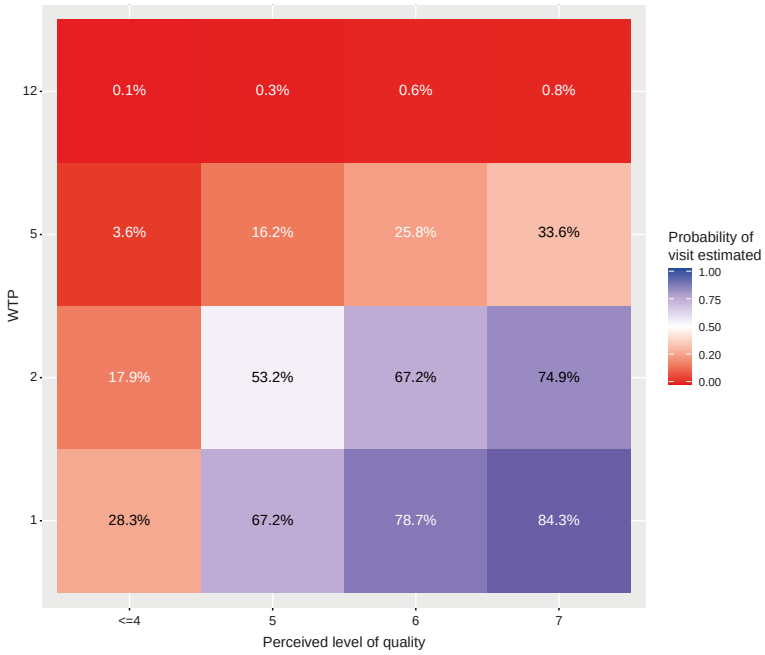
The bivariate model shows that both the variable price and the last two levels of perceived quality are significant in explaining hypothetical WTP to enter the VCs (Table 4). Visitors who rated service quality above a score of 6 show a better WTP ratio (2.237) than do those who perceive quality as less than or equal to 5. Those who rate quality at 7 show an improvement ratio of 2.6121 over those who perceive quality as less than or equal to 6.

	Estimate	Std. Error	z value	p-value
Intercept	-0.3388	1.1431	-0.296	0.7669
Price	-0.5908	0.0633	-9.332	<2e-16 **
P41 percibed quality 6	2.2373	1.1529	1.941	0.0523 **
P41 percibed quality 7	2.6121	1.1564	2.259	0.0239 *

Table 4. Model fit values (** p< 0.001; * p<0.05).

The bivariate plots show the estimated and observed probability that a visitor who perceives a specific level of quality would be willing to pay a specific price to visit the centre (Fig. 3). We estimate that 84.3% of visitors who rated their satisfaction at a value of 7 would be willing to pay one Euro to visit the centre. This percentage drops to 75% when the price rises to 2 Euros and decreases sharply when the price rises to 5 Euros (33.6%). All subgroups share this decreasing proportion of visitors as price increases with different ratings of satisfaction with the visit.

Estimated Probability



Observed probability

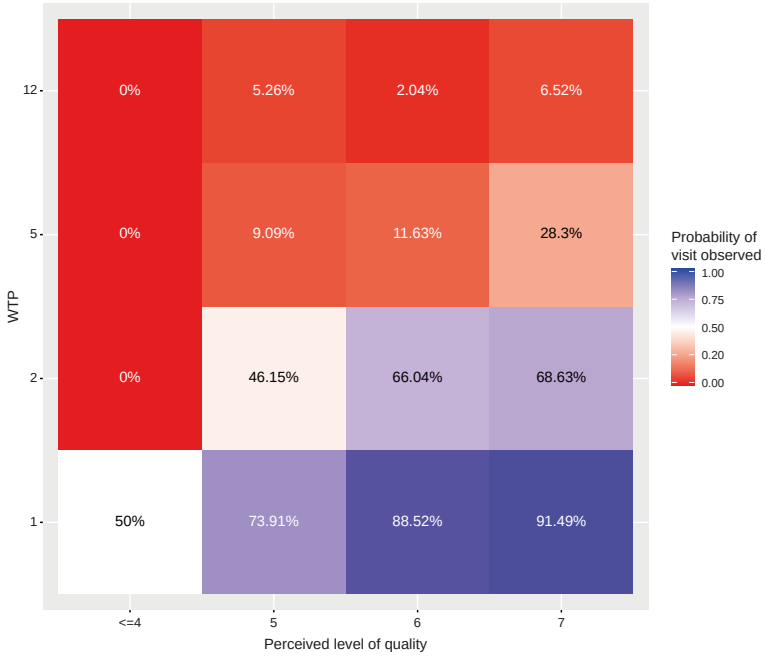


Fig. 3. Estimated and observed probability of WTP a fixed amount for a visit, according to perceived quality values.

4. Discussion

This study estimated the value of a hypothetical entrance fee to enjoy the RES environmental interpretation provided at VCs in the Andalusia's regional network of natural parks. It also determined which factors on a subjective scale measuring perceived quality of the visit to the centre best explain WTP. These variables not only lead visitors to attribute higher value to the centre; the study establishes a relationship between WTP a specific price and level of perceived quality of the visit. These results thus provide very useful, applicable information to guide managers in RES administration. They indicate the specific elements of VC management that managers must influence to improve users' subjective and monetary valuation of ES. The results thus help to prioritise public economic investment efforts to obtain higher returns on improvements centres can make.

Based on the responses of the maximum WTP freely given by respondents (Table 2), we simulate the fee as 2 Euros and the average WTP as 3.27 Euros. Although managers of these sites do not plan a priori to set entrance fees, this amount gives them an idea of the value visitors perceive for the recreational service they enjoy at the centre. The value obtained for this entrance fee is consistent with other similar studies on economic valuation of RES in natural areas.

Caparrós et al. (2017) estimated that the SEV fee for access to the entire PA (9 natural parks in southern Spain) was 12 Euros, a sum consistent with a 2-Euro fee to visit one centre, as well as the other recreational services that can be enjoyed in the natural park. Regarding the marginal WTP in our study (3.27 Euros), Ezebilo (2016) estimated the entry fee to the entire PAs in Sweden at 16 Euros. Ezebilo´s study amount is similar to that obtained by Zin et al. (2019), who assessed Popa Mountain National Park at 19 Euros. Other studies, such as Schirpke et al. (2020), show that this price depends greatly on the

site to be visited and can vary from 12.87 to 63.65 Euros (based on a study of Natura 2000 sites in Italy). Finally, Clough (2013) valued the entrance fee for an interpretation centre in New Zealand at 3.50 Euros per person, similar to the value obtained in our study.

The questionnaire also asked about WTP a specific amount (including the answer "no") and maximum WTP. Optimal price was calculated based on these answers. Setting the entrance fee at 2 Euros maximises total revenue, since many visitors asked their WTP 3, 5 or 12 Euros were not willing to pay those amounts but were willing to pay a smaller amount. This information is also useful for management of these centres when establishing entrance fees and seeking to maximise revenue (Table 2).

In addition to economically valuing a hypothetical entrance fee, the managers wished to estimate the value visitors place on recreational services and determine how to optimise and improve these services. The study thus also analysed which variables of perceived quality of the service explained WTP, in order of importance. The variables studied were derived from a validated scale to measure subjective value of recreational services at VCs in these natural parks (Moreno-Llorca et al., 2019). Not all variables were related to WTP to visit the centre, and not all explained this WTP with the same level of significance. Table 3 shows these performance variables, ordered from most to least power to explain the value visitors place on the centre. The variables that most explained the centre's value were related to good condition of facilities (cleanliness, good lighting, pleasant appearance, restroom in good condition), information (attractive, up-to-date, videos and infographics, maps and brochures available), good access to the centre and good service from staff. Managers with limited public investment resources could thus orient their actions towards these results. The factors identified are consistent with those identified in other similar studies (Crilley et al., 2012; Graefe and Burns, 2013; Lawton, 2012).

Finally, the study explores the relationship between visitor-perceived quality values and WTP an entrance fee at different prices. This information is very useful for recreational service management for several reasons. Firstly, it enables general prediction of the percentage of visitors willing to pay a specific price based on level of satisfaction obtained. Assessing perceived quality gives managers the information to evaluate any given centre's WTP-quality. These results identify the perceived quality score below which the RES' value plummets, enabling managers to decide the optimal point at which they wish to bring the whole network to a given centre. It follows from the bivariate graph (Fig. 3) that a perceived quality rating of less than 5 out of 7 drastically reduces ES value. Managers can also use assessment of these factors in their centre to identify the worst-rated services and target them for improvements, as such services may vary from centre to centre. Furthermore, although VCs are somewhat homogeneous, some have more resources (human, technical or infrastructural) than others. The study results thus enable each manager to determine the maximum potential of each centre in terms of the functionalities and recreational services it provides. For example, a centre that is unable to improve its accessibility should work to improve its quality of information, staff attention or interior facilities.

In conclusion, the study provides new information on research questions aimed at providing useful information for management. This study is just one case that seeks to bring useful information from science to management in PAs. An important part of its process is its use of different techniques to value RES jointly (in both monetary and subjective terms). This approach helps to operationalise the concept of ES and its valuation in practicalmanagement of these services in Andalusia's natural parks. Operationalisation of the ES framework also requires defining research objectives to avoid questions irrelevant to real-world applications. To ensure generation of data that did serve real-world applications, we established the questions together with the managers and the staff of the centres.

Acknowledgements

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Supplementary material

Supplement S1: VC's name in each PA

Visitor Center (VC)	VC Name	Protected Area (PA)
1	"Cabildo Viejo"	"Sierra de Aracena y Picos de Aroche" Natural Park
2	"Bahía de Cádiz"	"Bahía de Cádiz" Natural Park
3	"Venta Nueva"	"Sierra de Cardeña y Montoro" Natural Park
4	"Río Borosa"	"Sierras de Cazorla, Segura y Las Villas" Natural Park
5	"Guadiamar"	"Corredor Verde del Guadiamar" Protected Landscape
6	"Llanos de las Américas"	"Despeñaperros" Natural Park
7	"José Antonio Valverde"	"Laguna de Fuente de Piedra" Natural Reserve
8	"Puerto Lobo"	"Sierra de Huétor" Natural Park
9	"Los Villares"	"Los Villares" Periurban Park
10	"Anastasio Senra"	"Marismas del Odiel" Natural Park
11	"Dornajo"	"Sierra Nevada" National and Natural Park
12	"Los Yesares"	"Karst en Yesos de Sorbas" Natural Park

Conclusiones generales

Atendiendo al estudio sistemático de los resultados obtenidos en este trabajo de investigación y a los reflejados por otros autores e investigadores, a continuación, se reflejan las aportaciones más relevantes, agrupadas y coincidentes con las publicaciones ya realizadas.

Como primera aportación y conclusión general, el trabajo de investigación presenta un avance en el desarrollo de herramientas de evaluación de la gestión de espacios naturales protegidos y de ayuda a la toma de decisiones en el ámbito de los servicios ecosistémicos culturales y específicamente de recreación. El planteamiento de las cuestiones a analizar, acoplando las escalas temático-espacio-temporales entre al ámbito científico y de la gestión, han permitido generar herramientas e información que permite la evaluación de la gestión y la ayuda a la toma de decisiones.

Respecto a la evaluación de la gestión de las áreas protegidas en Andalucía, el novedoso enfoque analítico concluye que existe una correspondencia espacial entre la conservación de la naturaleza y el bienestar en el contexto de una región desarrollada, resultado que se detalla en las siguientes conclusiones:

- Encontramos un aumento significativo del bienestar en Andalucía desde 1989 hasta 2009, coincidiendo con la evolución de algunos indicadores que contribuyen al bienestar.
- Los municipios influenciados por un espacio natural protegido tienen una ratio de bienestar significativamente más alto que los situados en entornos no protegidos.
- El aumento del bienestar observado sigue un patrón espacial dentro de Andalucía, con mayor incremento del bienestar en algunas zonas de montaña, frente a la zona del Valle del Guadalquivir que muestra un incremento más leve del bienestar.

- Los municipios protegidos aumentan significativamente su ratio de bienestar independientemente de a) el tamaño del parque que los rodea y b) el porcentaje de su superficie afectada por el espacio protegido.

Respecto a la caracterización de visitantes y de sus experiencias en la naturaleza entre las Reservas de la Biosfera se recogen las siguientes aportaciones:

- A nivel descriptivo, existen diferentes distribuciones en el número de fotos asignadas a cada categoría de perfiles de visitantes y de sus experiencias en la naturaleza (servicios ecosistémicos culturales) entre las clasificaciones realizadas en el análisis de contenido y las indicadas por los usuarios de Flickr durante la encuesta online.

- En ambas Reservas de la Biosfera (Doñana y Sierra Nevada), "paisaje y especies" y "cultura y patrimonio" fueron las categorías más representadas de los perfiles de los visitantes y las experiencias basadas en la naturaleza, independientemente del método de clasificación (es decir, análisis de contenido o encuestas online).

- Por el contrario, el "ocio y deporte" estaba menos representado en comparación con el resto de categorías en Doñana. En el caso de Sierra Nevada, relacionadas con la "recreación y deportes" se pudo identificar una diversidad de actividades recreativas y deportivas, como el senderismo y el esquí.

En relación con la concordancia y discordancia entre el análisis de contenido y las encuestas online al analizar la caracterización de visitantes y sus experiencias en la naturaleza se han obtenido las siguientes conclusiones:

- Al evaluar la congruencia global entre los resultados obtenidos a partir de nuestro análisis de contenido fotográfico y de las encuestas de los usuarios de Flickr, en general, encontramos niveles de concordancia y precisión entre bajos y medios

- Se observaron valores de congruencia más altos para las experiencias basadas en la naturaleza en comparación con los perfiles de los turistas. Es más fácil interpretar una experiencia en la naturaleza a partir de una foto (es decir, "el qué") que inferir en el perfil social del turista (es decir, "el quién").

- El contexto socio-ecológico tiene influencia en el grado de congruencia, con mayores niveles de concordancia entre el análisis de contenido y las encuestas online para Doñana en comparación con Sierra Nevada.

- Asimismo, se encontró que el nivel de concordancia entre el análisis de contenido y las clasificaciones de las encuestas online depende de la categoría analizada.

- Por lo tanto, hemos observado que no existe una clara concordancia entre el análisis de contenido y las encuestas en línea, pero también que esta concordancia depende de la categoría de experiencia basada en la naturaleza que se analice y de su contexto socioecológico.

- Esto sugiere que, aunque el análisis de contenido y las encuestas en línea por separado pueden conducir a una información incompleta, su uso combinado puede proporcionar una evaluación más holística de los indicadores naturales y culturales.

Respecto al diseño de una herramienta en forma de escala de medición del servicio ecosistémico recreativo en centros de visitantes de espacios protegidos, se destacan las siguientes aportaciones:

- Se ha desarrollado una escala que cumple tanto los requisitos de la gestión como las condiciones de validez y fiabilidad exigidas a una buena escala de medición.

- Desde el punto de vista de la gestión, el cuestionario desarrollado es sencillo y funcional, garantizando la generación de una herramienta útil y directamente aplicable. Este instrumento puede ser utilizado

directamente o adaptado a la gestión del ocio en otras áreas protegidas con servicios parecidos.

- La metodología para desarrollar un nuevo instrumento de medición también puede aplicarse fácilmente a la evaluación de los servicios de recreación en las instalaciones de las áreas protegidas.

- Supone una novedad la aplicación de la técnica de incidentes críticos y análisis factorial confirmatorio para diseñar una herramienta que oriente la toma de decisiones en los centros de visitantes de áreas protegidas.

- El instrumento establece tres dimensiones para evaluar la valoración de los visitantes de los servicios prestados en los centros de visitantes: información, instalaciones y servicio recibido del personal.

En relación con la primera aplicación del cuestionario en los centros de visitantes, los principales avances son:

- Los gestores de las áreas protegidas han obtenido abundante información útil de este cuestionario. La primera es el alto valor de la satisfacción de los interesados con la experiencia recreativa en todos los centros.

- No existen diferencias significativas entre la percepción de los usuarios de los centros de visitantes en los parques naturales. Estos resultados confirman la homogeneidad del valor en toda la red, una cuestión muy importante para los gestores del servicio recreativo.

- Los factores socioculturales pueden explicar las percepciones y valores asignados a las actividades recreativas. Nuestro instrumento de medición es útil para que los gestores puedan identificar qué variables socioculturales influyen en la valoración de los visitantes.

- El instrumento de medición aquí diseñado permite a los gestores no sólo mejorar su conocimiento de los visitantes recreativos, sino también relacionarlos con la valoración de las actividades

recreativas. Esta información podría proporcionar a los gestores información para orientar las decisiones relativas a cuestiones como la educación ambiental, las actividades recreativas y las acciones de promoción orientadas a un tipo específico de usuario.

Por último, respecto a el uso mixto de métodos de valoración subjetiva y económica de los servicios de recreación en centros de visitantes, podemos destacar las siguientes aportaciones:

- Se estimó el valor de una hipotética entrada para disfrutar de los servicios ecosistémicos de recreación que se ofrece en los centros de visitantes en los parques naturales de Andalucía.

- Igualmente determinó qué factores de una escala subjetiva que mide la calidad percibida de la visita al centro explican significativamente la disponibilidad a pagar, además en qué orden de importancia.

- Existe una relación entre la disponibilidad a pagar un determinado precio y el nivel de calidad percibida de la visita.

- Se han identificado los elementos específicos de la gestión de los centros de visitantes en los que deben incidir los gestores para mejorar la valoración subjetiva y monetaria de los visitantes, lo que ayuda a priorizar los esfuerzos de inversión económica pública para obtener un mayor rendimiento de las mejoras que pueden realizar los centros.

- La metodología permite predecir de forma general el porcentaje de visitantes dispuestos a pagar un determinado precio en función del nivel de satisfacción obtenido y proporciona a los gestores la información necesaria para evaluar la disponibilidad a pagar y la valoración subjetiva un centro determinado.

- Los gestores también pueden utilizar la evaluación de estos factores en su centro para identificar los servicios peor valorados y dirigirlos a mejoras, ya que estos servicios pueden variar de un centro a otro.

- Así, esta metodología permite a cada gestor determinar el máximo potencial de cada centro en cuanto a las funcionalidades y servicios recreativos que ofrece. Por ejemplo, un centro que no pueda mejorar su accesibilidad deberá trabajar para mejorar su calidad de información, la atención del personal o las instalaciones interiores.

Futuras líneas de investigación

El desarrollo de este trabajo ha supuesto un avance en la gestión de las áreas protegidas en Andalucía, a través de casos de estudio, en la transferencia de conocimiento científico a problemas concretos de gestión. En general, la mejora de la interfaz ciencia-gestión es un reto por desarrollar en el futuro. Además, en el desarrollo de este trabajo, han surgido algunos aspectos derivados del mismo que necesitan de un análisis más detallado, por lo que se proponen a continuación las siguientes futuras líneas de investigación:

- Analizar más la relación entre conservación de espacios naturales, los servicios ecosistémicos que ofrecen y la sociedad que forma parte de estos espacios y la que vive fuera, pero disfruta igualmente de sus beneficios. Las áreas protegidas se convierten en puntos de suministro de estos servicios para toda la sociedad. Se hace necesario profundizar en la relación entre el bienestar de la sociedad y los espacios naturales.

- Por otro lado, el uso de las redes sociales como suministradoras de datos útiles para diferentes ámbitos de gestión sigue siendo un reto por resolver. Como hemos observado en nuestro estudio, esta información por sí sola aún no es lo suficientemente explicativa y necesita de información tomada en campo como complemento. Se hace preciso desarrollar metodologías científicas que aúnen campos interdisciplinares (ecología, inteligencia artificial, gestión de "big data") a la hora de mejorar herramientas que ayuden al gestor a tomar decisiones con información menos costosa y lenta de obtener.

- Respecto a la escala de medición desarrollada, esta metodología se puede extender a otras áreas protegidas, bien adaptando la escala, si los servicios culturales ofrecidos son muy similares, o bien volviendo a aplicar la misma metodología a otro tipo de experiencias de los visitantes en otros ámbitos en los espacios naturales protegidos.

- El uso mixto de técnicas de valoración subjetiva y económica ha aportado información muy útil a la gestión de los centros de visitantes. Esta metodología puede extrapolarse igualmente a otras áreas de gestión para obtener la información acerca de los visitantes en relación con otras áreas de gestión, que sea útil en la toma de decisiones.

- El presente trabajo se ha realizado en los espacios naturales de Andalucía, y sería muy interesante aplicar estas herramientas y metodologías en otras comunidades autónomas u otras redes (como la red de parques nacionales) para evaluar diferencias entre un conjunto más amplio de espacios naturales protegidos.

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