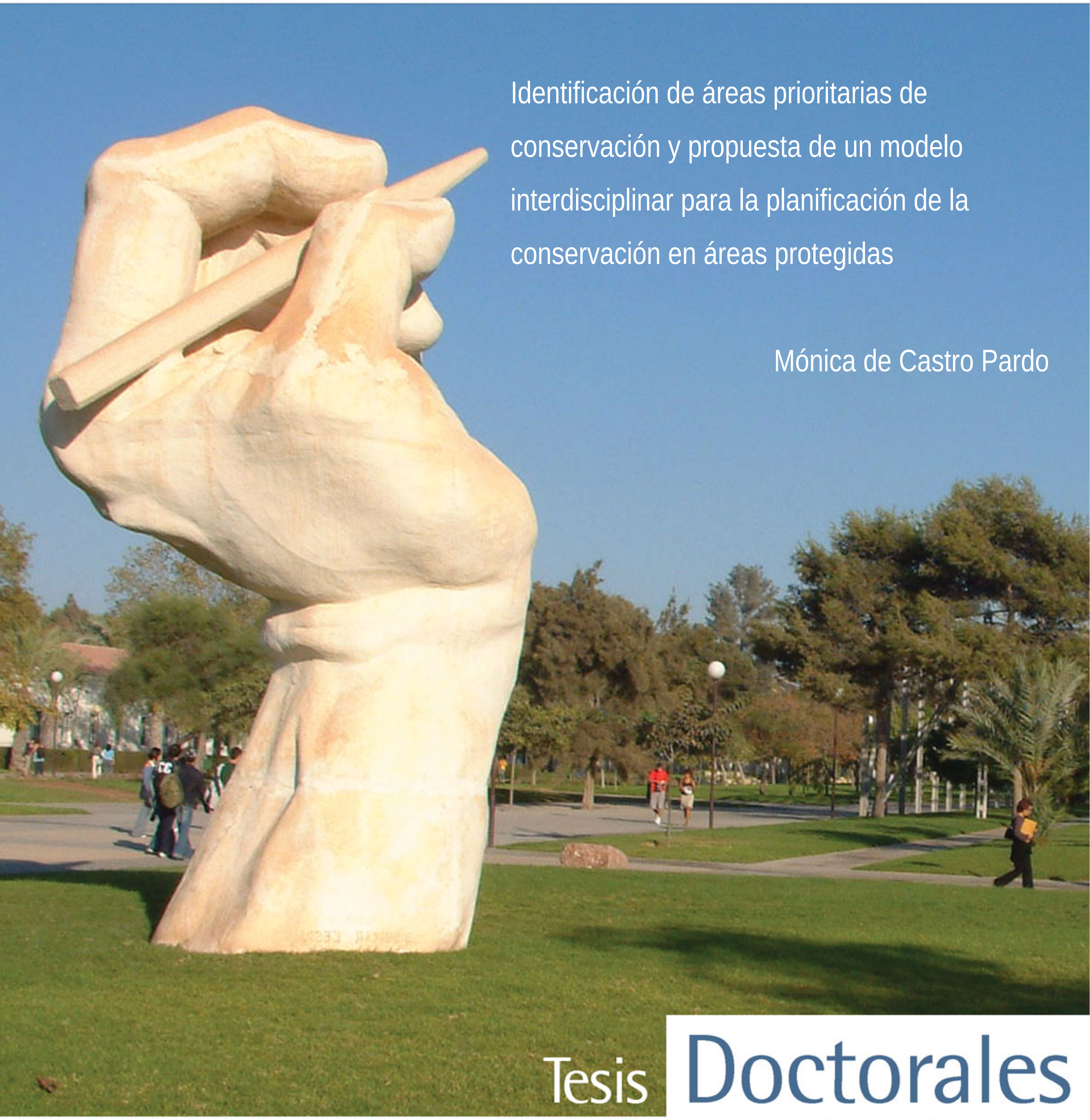
Universitat d'Alacant
Universidad de Alicante



Identificación de áreas prioritarias de conservación y propuesta de un modelo interdisciplinar para la planificación de la conservación en áreas protegidas

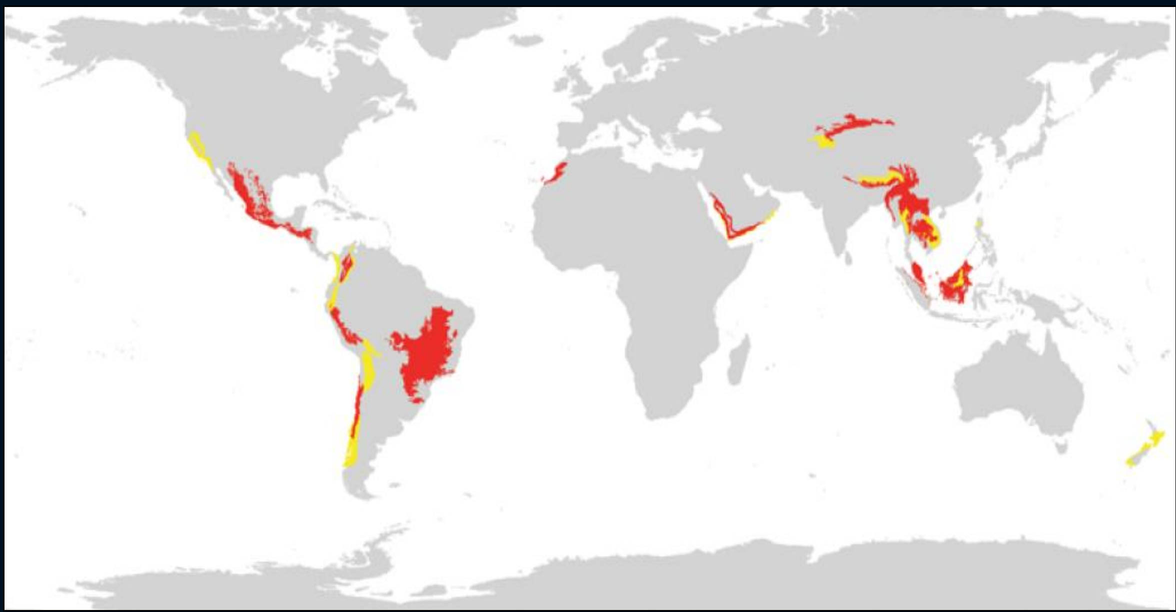
Mónica de Castro Pardo

Tesis Doctorales

www.eltallerdigital.com

UNIVERSIDAD de ALICANTE

IDENTIFICACIÓN DE ÁREAS PRIORITARIAS DE CONSERVACIÓN Y PROPUESTA DE UN MODELO INTERDISCIPLINAR PARA LA PLANIFICACIÓN DE LA CONSERVACIÓN EN ÁREAS PROTEGIDAS



Mónica de Castro Pardo

Instituto Universitario de Investigación CIBIO

Tesis Doctoral

Universidad de Alicante 2013

Universitat d'Alacant
Universidad de Alicante

IDENTIFICACIÓN DE ÁREAS PRIORITARIAS DE CONSERVACIÓN Y PROPUESTA DE UN MODELO INTERDISCIPLINAR PARA LA PLANIFICACIÓN DE LA CONSERVACIÓN EN ÁREAS PROTEGIDAS

Universitat d'Alacant
Universidad de Alicante

Mónica de Castro Pardo

Instituto Universitario de Investigación CIBIO

Universidad de Alicante, 2013

A mis hijos y a mis padres

"Y si yo sé de una flor única en el mundo y que no existe en ninguna parte más que en mi planeta; si yo sé que un buen día un corderillo puede aniquilarla sin darse cuenta de ello, ¿es que esto no es importante?"

Antoine de Saint-Exupery – "El Principito"

Universitat d'Alacant
Universidad de Alicante

Instituto Universitario de Investigación CIBIO

Universidad de Alicante, 2013

Identificación de áreas prioritarias de conservación y propuesta de un modelo interdisciplinar para la planificación de la conservación en áreas protegidas.

Tesis presentada por Mónica de Castro Pardo

para optar al grado de Doctora

Mónica de Castro Pardo

Alicante, 2013

Tesis presentada por Doña MÓNICA DE CASTRO PARDO para optar al grado de Doctora por la Universidad de Alicante

Fdo. Mónica de Castro Pardo

Director: Dr.VICENTE URIOS MOLINER

Fdo. Vicente Urios Moliner

Profesor Titular

Universidad de Alicante

ÍNDICE

ÍNDICE DE TABLAS Y FIGURAS

INTRODUCCIÓN GENERAL

MÉTODOS GENERALES Y OBJETIVOS

CAPÍTULO 1

CAPÍTULO 2

CAPÍTULO 3

CAPÍTULO 4

SÍNTESIS GENERAL

Medio Atlas (Marruecos). Foto: V. Urios.

Las áreas protegidas pueden considerarse sistemas ecológicos y sociales (Anderies et al.,2004; Ostrom,2009) en el sentido que interviene un gran número de agentes sociales con intereses contrarios interaccionando en ecosistemas muchas veces valiosos y vulnerables.

Las ciencias ecológicas y sociales se han desarrollado tradicionalmente de manera independiente y resulta difícil combinarlas ya que sus objetivos son muchas veces contrarios (Gibson et al., 2000). Sin embargo, es necesario integrar ambas ramas del conocimiento para que la conservación de los ecosistemas sea eficaz. Es más, cuando se encuentran sinergias en sus objetivos las estrategias de conservación pueden ser más eficientes (Balmford et al.,2002) que si se diseñan de manera independiente (Rodrigues et al.,2004b). Las áreas protegidas forman parte de un marco institucional que condiciona en gran medida el comportamiento de los individuos y donde las instituciones deben desarrollar eficientemente dos funciones clave para conservar los comunes:(i) restringir el acceso y (ii) generar incentivos para la conservación (Ostrom, 1999). Para ello, la gestión de las áreas protegidas debe construirse sobre una base de buen gobierno que debe estar presente en todo el proceso de planificación (Lockwood,2010). Tanto en el diseño de redes de reservas como en la planificación estratégica de la gestión, deben considerarse de manera conjunta los objetivos ecológicos, pero también los objetivos sociales, económicos y políticos. Esta tesis doctoral propone un modelo interdisciplinar que plantea una estrategia eficiente en términos de costes que permite identificar áreas para la expansión de la red de espacios protegidos considerando los objetivos políticos del Convenio de Diversidad Biológica (CDB), define un marco de trabajo para el buen gobierno de las áreas protegidas sobre el que construir los elementos de la gestión, identifica el análisis multi-criterio en la toma de decisiones colaborativas como una herramienta útil para implementar el buen gobierno en las áreas protegidas y aplica esta técnica en el diseño de un modelo multi-criterio para la toma de decisiones capaz de identificar prioridades sobre los objetivos de gestión de los agentes sociales y encontrar equivalencias con las categorías internacionales de protección definidas por IUCN.

El objetivo general de la tesis es identificar áreas prioritarias de protección y proponer un modelo de planificación de la conservación válido para la red mundial de áreas protegidas que permite definir el buen gobierno en áreas protegidas y proponer herramientas para implementarla a través de la gestión

Los objetivos específicos son:

- Identificar áreas prioritarias de protección considerando objetivos políticos y científicos de conservación.
- Definir los principios de buen gobierno en áreas protegidas desde un enfoque institucional.
- Realizar una revisión exhaustiva del empleo del análisis multi-criterio en la toma de decisiones en áreas protegidas y mostrar su utilidad para incluir la participación de los agentes sociales.
- Proponer una herramienta multi-criterio que incluye la participación de los agentes de un espacio natural para identificar categorías internacionales de protección en base a prioridades sobre los objetivos de gestión.

CAPÍTULO 1. Relacionando objetivos políticos y científicos para la conservación de la biodiversidad global: implicaciones para la expansión de la red global de áreas protegidas.

A pesar de que la red mundial de áreas protegidas cubre el 12 % de la superficie terrestre, su rendimiento todavía no es satisfactorio. Aunque los objetivos políticos y científicos generalmente utilizan diferentes enfoques en las principales tareas, nosotros mostramos en términos de áreas prioritarias para la expansión de la red global de reservas que existe un gran acuerdo entre los objetivos políticos del Convenio de Diversidad Biológica (CDB) y los objetivos científicos derivados de organizaciones internacionales de conservación. Nosotros analizamos cuatro bases de datos globales para identificar áreas prioritarias que no alcanzan el objetivo del 10 % para cada región ecológica sin áreas protegidas, y comparamos la distribución de las áreas prioritarias para la conservación de la biodiversidad global con base científica identificadas por Conservation International, WWF y Wildlife Conservation Society. Para el 63% (549) de las ecoregiones terrestres del mundo el objetivo CDB 10 % no se alcanza; requiriéndose proteger el 4.6% de la superficie terrestre (6,239,894 km2) para alcanzarlo.Al menos el 78% de las regiones prioritarias para alcanzar este objetivo son también regiones prioritarias para las principales estrategias de conservación global. De esta forma, alcanzar el objetivo político del CDB permitiría obtener ganancias en términos del logro de objetivos globales de conservación.

CAPÍTULO 2. Un marco teórico para analizar la gobierno de áreas protegidas desde una perspectiva institucional.

El gobierno en las áreas protegidas ha adquirido una importancia creciente en los últimos años. La complejidad de los procesos de toma de decisiones requiere diseñar las relaciones de poder en base a unos criterios de calidad. En este trabajo planteamos un marco teórico de buen gobierno en áreas protegidas desde una perspectiva institucional, considerando el área protegida como una institución ecológica y social capaz de generar incentivos de cooperación en los agentes para lograr una acción colectiva eficiente. Nosotros definimos un gobierno de calidad en áreas protegidas en base a siete principios: legitimidad, inclusividad, rendición de cuentas, rendimiento, equidad, conectividad y sostenibilidad institucional. Estos atributos diseñan la base institucional sobre la que desarrollar una arquitectura ecológica, social, política y económica sostenible y que, implementada a través de una gestión eficiente permitirá alcanzar los objetivos sociales y de conservación del área protegida. Este enfoque holístico permite, por un lado, incorporar elementos asociados a la calidad institucional que no se encuentran suficientemente representados en los modelos actuales de evaluación del gobierno en áreas protegidas, y por otro, sentar las bases teóricas para definir modelos de evaluación del gobierno válidos para la Red Mundial de Áreas Protegidas.

CAPÍTULO 3. Una revisión crítica de Toma de Decisiones Multi-criterio en áreas protegidas.

El análisis multi-criterio en la toma de decisiones colaborativa puede constituir una herramienta útil para implementar el buen gobierno en áreas protegidas, donde existen fuertes conflictos de interés entre agentes sociales. Este artículo ofrece una revisión en profundidad y un análisis sobre los métodos multi-criterio para la toma de decisiones en áreas protegidas. Este análisis ha considerado los temas:diseño de áreas protegidas, uso de la tierra, gestión y especies y se ha basado en dos dimensiones: métodos y participación. Los temas y la participación han mostrado relación significativa usando una prueba Chi-cuadrado. Se han identificado dos grupos por tema: los problemas sobre diseño de áreas protegidas y especies usan métodos contínuos y no incluyen las preferencias de los agentes sociales. Por otro lado los problemas sobre uso de la tierra y gestión usan métodos discretos donde la participación es cada vez mayor. El impulso de las técnicas participativas con análisis multi-criterio promueve procesos de toma de decisiones adaptados a los agentes sociales, que utilizan técnicas de fácil comprensión y que manejan la incertidumbre debida a la imprecisión de las preferencias individuales. Finalmente incorporamos el valor ecológico y la vulnerabilidad con un análisis específico sobre regiones Biodiversity Hotspots.

CAPÍTULO 4. Identificando equivalencias con las categorías internacionales de áreas protegidas usando análisis multi-criterio en toma de decisiones colaborativa.

La evaluación de la gestión internacional en áreas protegidas presenta graves problemas derivados de la heterogeneidad en la asignación de categorías de protección. El sistema de categorías de gestión de UICN ha sido muy útil para promover sistemas de áreas protegidas en muchos países, reducir la confusión y establecer bases de datos comparables a nivel mundial, como la World Database Protected Areas (WDPA). Por otro lado el empleo de análisis multi-criterio en toma de decisiones colaborativa permite incorporar las preferencias de los agentes sociales en la toma de decisiones de una manera estructurada. Este artículo presenta un modelo multi-criterio de ayuda a la toma de decisiones (Multi-criteria Decision Support Model) que incorpora las preferencias de los agentes sociales. Este modelo permite obtener prioridades sobre los objetivos de gestión de los agentes sociales en un área protegida e identificar equivalencias con las categorías de protección UICN usando una técnica de análisis multi-criterio basado en relaciones de superación . También se presenta una aplicación en el Parque Natural de la Albufera de Valencia, un humedal fuertemente antropizado de la Comunidad Valenciana. Este trabajo constituye una aportación para el desarrollo de sistemas de información comparables en la red de espacios protegidos del mundo y contribuye a mejorar la evaluación de su gestión incorporando los principios de buen gobierno.

INTRODUCCIÓN GENERAL

Desierto de Rub-al-Kali (Arabia Saudí). Foto : V. Urios.

1. ÁREAS PRIORITARIAS DE CONSERVACIÓN Y LA RED MUNDIAL DE ÁREAS PROTEGIDAS

1.1. Conservación de la diversidad biológica.

La conservación de la diversidad biológica es uno de los grandes debates que se han mantenido a lo largo del tiempo (Balmford et al.,2002; Costanza et al., 1997).

Para el estudio de la biodiversidad es importante seleccionar identificadores cuantificables para determinar su estado a lo largo del tiempo. La biodiversidad comprende varios niveles de organización biológica (figura 1): paisaje regional, ecosistemas de las comunidades, población de especies y genética (Noss, 1990). La elección del nivel como base de trabajo en tareas de conservación ha generado controversias que actualmente continúan sin resolverse (Brooks et al., 2004; Cowling et al., 2004). Sin embargo, una buen manera de preservar la diversidad biológica total de comunidades biológicas intactas es protegiendo los hábitats que las contienen (Primack and Ros, 2002).

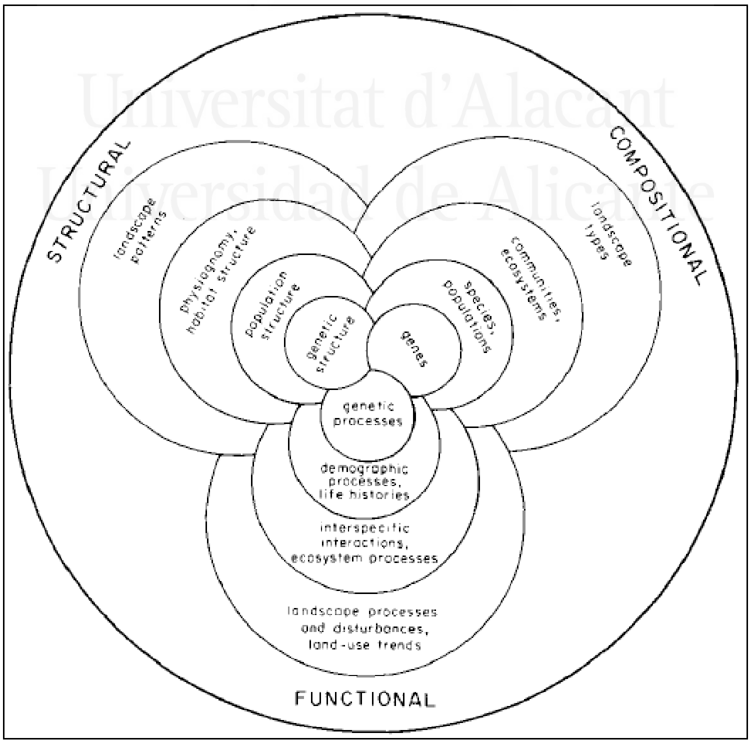


Figura 1. Aspectos funcionales, estructurales y de composición de la biodiversidad (Fuente: Noss, 1990).

Siguiendo este enfoque, en la sección I de esta tesis doctoral se han tomado como unidad de trabajo las ecoregiones terrestres.

Se define "ecoregión" como una unidad de tierra o agua relativamente grande que alberga una serie de comunidades naturales distintas que comparten un gran número de especies, dinámicas y condiciones ambientales. En la ecoregión ocurren los principales procesos evolutivos y ecológicos que crean y mantienen la biodiversidad (Conservation International ,2005).

Olson et al. (2001) identificaron 867 ecoregiones terrestres en el mundo.

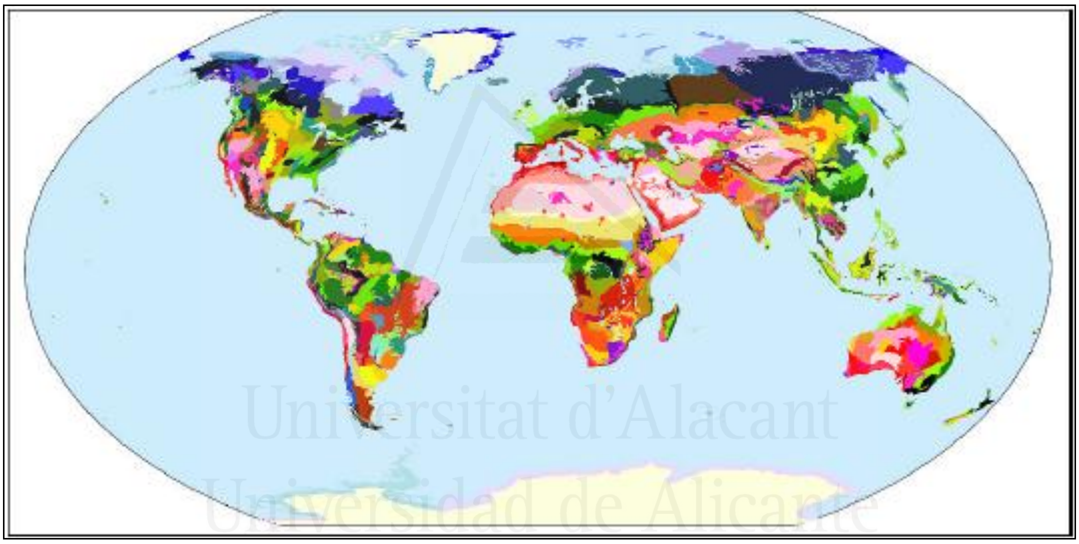


Figura 2. Ecoregiones terrestres del mundo (Fuente: Olson et al., 2001).

El objetivo del estudio de la biodiversidad a nivel de ecoregión es identificar y representar geográficamente una configuración de áreas prioritarias críticas para mantener la biodiversidad, desde esta perspectiva.

Este enfoque pretende alcanzar unas metas básicas en biología de la conservación:

- Representar las diferentes comunidades naturales con planes de conservación y redes de áreas protegidas.
- Mantener los procesos ecológicos y evolutivos para crear y mantener la

biodiversidad.

- Mantener poblaciones viables de especies autóctonas .

La conservación a nivel de ecoregión supone una aproximación para los planes de conservación y de acción a través de ecoregiones, como Global 200 Ecoregions. Estas estrategias están basadas en las ecoregiones; capturan patrones a gran escala de diversidad biológica y los procesos ecológicos que los contienen.

Los principios básicos de la conservación ecoregional son:

• Realizar planes de conservación e implementarlos trabajando a escala de ecosistemas naturales.

• Articular una visión de la biodiversidad que conserva un gran número de especies, hábitats naturales y procesos ecológicos característicos de una ecoregión a largo plazo.

El primer paso en conservación de ecoregiones consiste en identificar hábitats naturales, procesos ecológicos y variables poblacionales que serán precisos para conservar un gran rango de biodiversidad en una ecoregión a largo plazo. El final de este proceso es una visión de la biodiversidad que aporte áreas prioritarias o incluso redes de conservación específicos que protegerían la ecoregión para conservar su biodiversidad y sus procesos ecológicos en el futuro (WWF, 2005) .

1.2.Áreas protegidas

Una forma de conservar comunidades biológicas es el establecimiento y/ó ampliación de áreas protegidas legalmente. La cobertura de áreas protegidas es un indicador muy utilizado de la conservación de la biodiversidad (Chape et al.,2005), de hecho es uno de los indicadores que se han propuesto para evaluar objetivos del Convenio de Diversidad Biológica, como “2010 Target” (Balmford et al.,2005).

En el diseño de áreas protegidas deben tenerse en cuenta algunas cuestiones básicas:

a) La forma de preservar la diversidad biológica varía con el grado en que están afectadas por actividades humanas. Así, la gestión debe ser diferente en áreas que no están afectadas por actividades humanas y en áreas muy antropizadas. Los hábitats con niveles intermedios de conservación plantean algunos retos y oportunidades más interesantes para la biología de la conservación, porque a menudo cubren grandes áreas (Primack and Ros, 2002).

b) Cuando se establece un área de conservación es necesario encontrar intereses comunes entre la protección de la diversidad biológica y de las funciones de los ecosistemas y la satisfacción de las necesidades inmediatas y a largo plazo de la población local y del gobierno nacional. La conservación en un área protegida debe ser hacer compatible la conservación de la biodiversidad y el desarrollo de las poblaciones locales.

c) En la elaboración de planes de conservación es necesario, entre otros aspectos, revisar áreas de conservación existentes y seleccionar áreas de conservación adicionales (Margules and Pressey, 2000).

Las red mundial de áreas protegidas.

La Unión Internacional para la Conservación de la Naturaleza (UICN), fundada en 1948, agrupa a Estados soberanos, agencias gubernamentales y una diversa gama de organizaciones no gubernamentales, en una alianza única: más de 1000 miembros diseminados en cerca de 160 países. Como Unión, la UICN busca influenciar, alentar y ayudar a los pueblos de todo el mundo a conservar la integridad y la diversidad de la naturaleza, y a asegurar que todo uso de los recursos naturales sea equitativo y ecológicamente sustentable. La UICN fortalece el trabajo de sus miembros, redes y asociados, con el propósito de realzar sus capacidades y apoyar el establecimiento de alianzas globales para salvaguardar los recursos naturales a nivel local, regional y global (Dudley, 2008).

La IUCN ha creado la World Database on Protected Areas, que cuenta actualmente con 159.908 áreas protegidas (Figura 3). Las áreas protegidas terrestres en particular, suponen un 12.7 % de la superficie de la Tierra (IUCN and UNEP-WCMC, 2011).

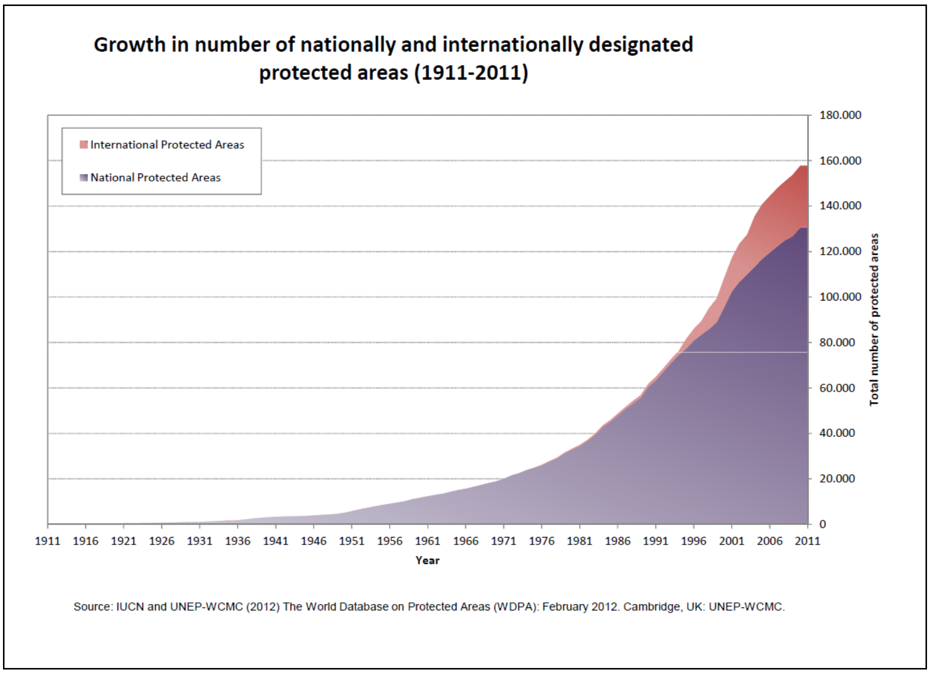


Figura 3. Incremento en el número de áreas protegidas nacionales e internacionales entre 1911 y 2011 (Fuente: IUCN WCMC (2012) The World Database on Protected Areas (WDPA)).

La UICN ha elaborado un sistema de clasificación de las áreas protegidas que abarca desde el uso mínimo del hábitat al uso intensivo por parte de los seres humanos, y que se basa en objetivos de gestión (Tabla 1).

Las categorías I-IV coinciden con la definición de área estrictamente protegida de World Conservation Union y en ocasiones son denominadas reservas. El papel básico de las reservas es separar los elementos de la biodiversidad de los procesos que amenazan su existencia en la vida silvestre (Margules and Pressey, 2000). Por otro lado, las categorías V y VI consideran la conservación de la diversidad biológica un objetivo secundario frente al uso sostenible de los recursos naturales. No obstante, el sistema de categorías de protección de IUCN es un sistema ágil que se encuentra en contínua revisión. La última revisión para la asignación de categorías puso el énfasis sobre la conservación de la naturaleza, la protección a largo plazo y la eficacia de la gestión (Dudley et al., 2010).

Ia-Reserva Natural Estricta: Las áreas de Categoría Ia son áreas estrictamente protegidas reservadas para proteger la biodiversidad así como los rasgos geológicos/geomorfológicos en las cuales las visitas, el uso y los impactos están estrictamente controlados y limitados para asegurar la protección de los valores de conservación. Estas áreas protegidas pueden servir como áreas de referencia indispensables para la investigación científica y el monitoreo. **Ib-Área Natural Silvestre:** Son generalmente áreas no modificadas o ligeramente modificadas de gran tamaño, que retienen su carácter e influencia natural, sin asentamientos humanos significativos o permanentes, que están protegidas y gestionadas para preservar su condición natural. **II-Parque Nacional:** Grandes áreas naturales o casi naturales establecidas para proteger procesos ecológicos a gran escala, junto con el complemento de especies y ecosistemas característicos del área, que también proporcionan la base para oportunidades espirituales, científicas, educativas,recreativas y de visita que sean ambiental y culturalmente compatibles. **III-Monumento Natural:** Se establecen para proteger un monumento natural concreto, que puede ser una formación terrestre, una montaña submarina, una caverna submarina, un rasgo geológico como una cueva o incluso un elemento vivo como una arboleda antigua.Normalmente son áreas protegidas bastante pequeñas y a menudo tienen un gran valor para los visitantes. **IV-Área de manejo de Hábitat/Especies:** El objetivo es la protección de hábitats o especies concretas y su gestión refleja dicha prioridad. Muchas áreas protegidas de categoría IV van a necesitar intervenciones activas habituales para abordar las necesidades de especies concretas o para mantener hábitats, pero esto no es un requisito de la categoría. **V-Paisaje Terrestre y Marino Protegido:** Un área protegida en la que la interacción entre los seres humanos y la naturaleza ha producido un área de carácter distintivo con valores ecológicos, biológicos, culturales y estéticos significativos; y en la que salvaguardar la integridad de dicha interacción es vital para proteger y mantener el área, la conservación de su naturaleza y otros valores. **VI-Área Protegida con Gestión de Recursos:** Las áreas protegidas de categoría VI conservan ecosistemas y hábitats, junto con los valores culturales y los sistemas tradicionales de gestión de recursos naturales asociados a ellos. Normalmente son extensas, con una mayoría del área en condiciones naturales, en las que una parte cuenta con una gestión sostenible de los recursos naturales, y en las que se considera que uno de los objetivos principales del área es el uso no industrial y de bajo nivel de los recursos naturales, compatible con la conservación de la naturaleza.

Tabla 1. Categorías de Protección IUCN (based in IUCN, 2008).

Las áreas protegidas en la Comunidad Valenciana.

La Generalitat Valenciana ha establecido siete categorías de protección para los espacios naturales protegidos valencianos: Parques Naturales, Parajes Naturales, Parajes Naturales Municipales, Reservas Naturales, Monumentos Naturales, Sitios de Interés y Paisajes Protegidos (tabla 2). La asignación de categorías de protección se realiza según los recursos naturales y biológicos y los valores que contengan los espacios naturales protegidos (Ley 11/94 de Espacios Naturales Protegidos de la Comunidad Valenciana).

Parque Natural: Los parques naturales son áreas naturales que, en razón a la representatividad de sus ecosistemas o a la singularidad de su flora, su fauna, o de sus formaciones geomorfológicas, o bien a la belleza de sus paisajes, poseen unos valores ecológicos, científicos, educativos, culturales o estéticos, cuya conservación merece una atención preferente y se consideran adecuados para su integración en redes nacionales o internacionales de espacios protegidos.

Paraje Natural : Constituyen parajes naturales las áreas o lugares naturales que, en atención a su interés para la Comunidad Valenciana, se declaren como tales por sus valores científicos, ecológicos, paisajísticos o educativos, con la finalidad de atender a la protección, conservación y mejora de su fauna, flora, diversidad genética, constitución geomorfológica o especial belleza.

Paraje Natural Municipal: Constituirán parajes naturales municipales las zonas comprendidas en uno o varios términos municipales que presenten especiales valores naturales de interés local que requieran su protección, conservación y mejora y sean declaradas como tales a instancias de las entidades locales.

Reservas Naturales: Las reservas naturales son espacios naturales cuya declaración tiene como finalidad la preservación íntegra de ecosistemas, comunidades o elementos biológicos o geomorfológicos que, por su rareza, fragilidad, importancia o singularidad, merecen una valoración especial y se quieren mantener inalterados por la acción humana.

Monumentos Naturales: Los monumentos naturales son espacios o elementos de la naturaleza, incluidas las formaciones geomorfológicas y yacimientos paleontológicos, de notoria singularidad, rareza o belleza, que merecen ser objeto de una protección especial por sus valores científicos, culturales o paisajísticos.

Sitios de Interés: Podrán declararse como sitios de interés aquellos enclaves territoriales en que concurran valores merecedores de protección por su interés para las ciencias naturales.

Paisajes Protegidos: Los paisajes protegidos son espacios, tanto naturales como transformados, merecedores de una protección especial, bien como ejemplos significativos de una relación armoniosa entre el hombre y el medio natural, o bien por sus especiales valores estéticos o culturales.

Tabla 2. Categorías de espacios naturales protegidos en la Comunidad Valenciana (Ley 11/94 de Espacios Naturales Protegidos de la Comunidad Valenciana).

La Red de Espacios Protegidos de la Comunidad Valenciana está formada por veintidós parques naturales, ocho paisajes protegidos y un monumento natural (Figura 4) y supone el 9 % del territorio de la Comunidad Valenciana con un total de 206841 ha (GVA,2011).

Figura 4. Red de espacios naturales de la Comunidad Valenciana (Fuente: GVA, 2011).

El Parque Natural de la Albufera de Valencia.

El Parque Natural la Albufera de Valencia es un humedal costero protegido de Valencia. Fue declarado Parque Natural en 1986 e incluida en la lista RAMSAR de humedales internacionales en 1991 que la reconoce como área de especial protección (SPA). Comprende una superficie de 21120 ha , dos tercios de los cuales se dedican al cultivo del arroz y se distribuyen en pequeñas parcelas de propiedad privada. La presión antrópica en la última centuria ha sido muy intensa. Además el uso agrario, la actividad pesquera y cinegética ó el uso público en general han originado confrontamientos entre agentes con diferentes intereses.

Las características ecológicas vienen determinadas por cuatro ambientes (GVA, 2010):

La Restinga. Cuenta a su vez con cuatro subambientes: la playa, el cordón de dunas delanteras, el sistema dunar interno (colonizado por una densa vegetación de matorral y pinar), y las malladas (pequeños saladares situados entre las dunas). Tiene una anchura próxima al kilómetro y se encuentra atravesada por tres canales (*goles*) que comunican l'Albufera con el mar. En este enclave, en los que se desarrollan las típicas comunidades halófilas, se localiza la totalidad de las colonias de aves marinas nidificantes.

El Marjal. Constituye el ambiente más característico de este espacio natural protegido, así como el de mayor extensión, con 14.000 Ha dedicadas, casi exclusivamente, al cultivo del arroz. El marjal se ha visto afectado por procesos históricos de drenaje, irrigación y aterramiento, que ha determinado un paisaje agrario intensivo, caracterizado por una inundación intermitente, atendiendo a las necesidades del cultivo del arroz y a ciertos usos tradicionales, como la caza, en invierno.

L'Albufera. La laguna actual cuenta con un cinturón de vegetación palustre y diversas islas (*mates*), asentadas en las zonas de menor profundidad (*alterons*), donde se desarrollan comunidades de helófitos (eneales y carrizales principalmente). Estas islas y orillas ocupan una extensión aproximada de 350 Ha y constituyen importantes enclaves para la conservación de las aves acuáticas reproductoras y de valiosas comunidades botánicas.

El Monte. Se halla escasamente representado. Únicamente cabe resaltar los relieves de origen cretácico situados en los términos municipales de Cullera (*El Cabeçol y la Muntanya de Les Raboses*) y en el de Sueca *(La Muntanyeta dels Sants).*

En estos sistemas, de apenas 60 metros de cota, se desarrollan comunidades botánicas características de matorral mediterráneo.

Esta diversidad de ambientes ha permitido la presencia de una gran diversidad de especies. La Albufera cuenta con una importante comunidad de aves acuáticas, entre las que se encuentran especies amenazadas como la Cerceta Pardilla *Marmaronetta angustirostris*. En este espacio han sido citadas más de 250 especies de aves, de las cuales nidifican regularmente unas 90. Entre estas últimas cabe destacar a las ardeidas , contabilizándose algunos años más de 7000 parejas y otros larolimícolas, como gaviotas, charranes y limícolas, con más de 4000 parejas. Además cuenta con endemismos de especies ictícolas, como el Samaruc**,** *Valencia hispánica* y una gran diversidad de flora (Segarra and Dies,2008).

Las características socio-económicas se definen en base a dos elementos: un elevado grado de antropización y gran diversidad normativa.

El Parc Natural de l'Albufera engloba 13 municipios de Valencia, Sedaví, Alfafar, Massanassa, Catarroja, Albal, Beniparrell, Silla, Sollana, Algemesí, Albalat de la Ribera, Sueca y Cullera. De modo que el área de influencia del parque natural afecta a un total de 1.008.188 habitantes (GVA.,2011). Esto implica que el grado de antropización del parque de la Albufera sea muy alto. El uso agrario, la actividad cinegética tradicional, la actividad pesquera profesional, el uso público y el régimen urbanístico son las actividades contempladas en el Plan Rector de Uso y Gestión de este espacio protegido. Aunque la actividad económica más importante es el cultivo del arroz., que ocupa 14500 ha.

Por otro lado la gran complejidad normativa se refleja en la diversidad de figuras de protección existentes en el parque natural (Tabla 3). La densidad poblacional en el entorno del parque y la diversidad normativa complica la gestión y dificulta la comunicación en un contexto con un gran número de agentes sociales con diferentes intereses.

Figura de Protección	Fecha de declaración	Municipios	Superficie (ha)	Normativa
Parque Natural	1986	Valencia, Sedaví, Alfafar, Massanassa, Catarroja, Albal, Beniparrell, Silla, Sollana, Algemesí, Albalat de la Ribera, Sueca y Cullera	21120	
Zona RAMSAR	1990	Valencia, Sedaví, Alfafar, Massanassa, Catarroja, Albal, Beniparrell, Silla, Sollana, Algemesí, Albalat de la Ribera, Sueca y Cullera.	21120	Artículo 2.1 de la Convención sobre Humedales Ramsar
Área ZEPA (Zona de Especial protección para Aves)	1994	Valencia, Sedaví, Alfafar, Massanassa, Catarroja, Albal, Beniparrell, Silla, Sollana, Algemesí, Albalat de la Ribera, Sueca y Cullera.	21120	La Directiva 94/24/CE, de 8 de junio de 1994, relativa a la Conservación de las Aves Silvestres
LIC (Lugar de Interés Comunitario)	1992	Valencia, Sedaví, Alfafar, Massanassa, Catarroja, Albal, Beniparrell, Silla, Sollana, Algemesí, Albalat de la Ribera, Sueca y Cullera.	27538	Directiva 92/43/CEE del Consejo, de 21 de mayo de 1992, relativa a la conservación de los hábitats naturales y de la fauna y flora silvestres.
Microrreservas:				
Llacuna del Samaruc	2002	Algemesí	1186	Orden de 22 de octubre de 2002, de la Consellería de Medio Ambiente
Muntanyeta dels Sants	2006	Sueca	0.63	ORDEN de 17 de julio de 2006, de la Conselleria de Territorio y Vivienda, por la que se declaran 16 microrreservas vegetales en la provincia de Valencia
Cap de Cullera	1999	Cullera	0.2	ORDEN de 4 de mayo de 1999, de la Conselleria de Medio Ambiente.

Tabla 3. Figuras de protección en la Albufera de Valencia (GVA, 2010).

1.3. Estrategias internacionales de conservación.

La identificación de áreas prioritarias de conservación para la expansión de la red mundial de áreas protegidas no ha alcanzado un consenso entre científicos y conservacionistas (Hoekstra et al.,2005; Rodrigues et al 2004b). Estas diferencias son debidas por un lado, a la forma de valorar la biodiversidad (Cowling et al.,2004; Noss, 1990) y por otro lado, a los diferentes criterios para priorizar la conservación (Brooks et al.,2006; Orme et al.,2005).

Sin embargo Brooks et al.(2006) identificaron tres grandes estrategias internacionales de conservación que conjuntamente identifican el 78% de la superficie terrestre como prioritaria de conservación. Estas tres grandes estrategias son: Biodiversity Hotspots (BH), Global 200 (G200) y Last of the Wild (LW).

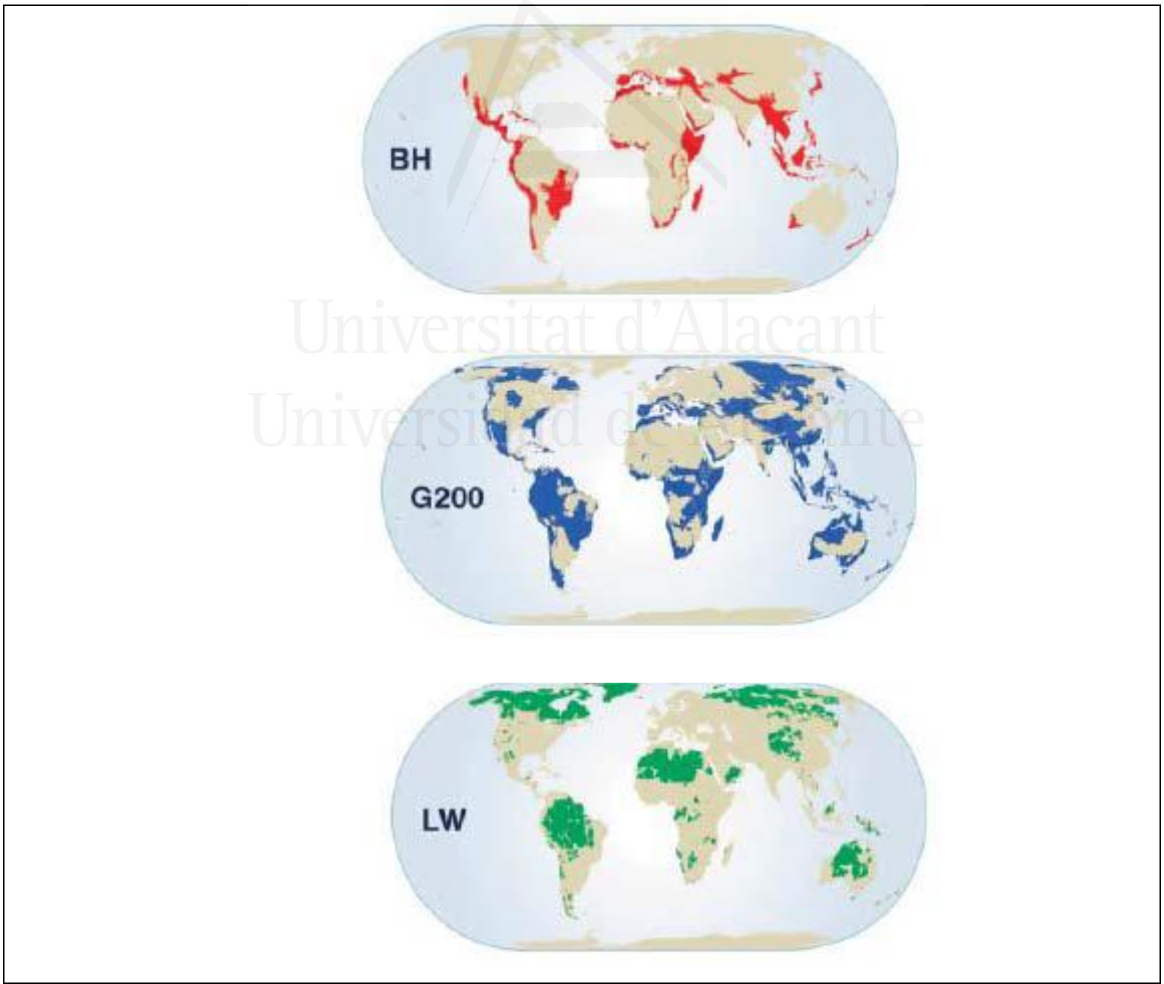


Figura 5. Biodiversity Hotspot, Global 200 y Last of the Wild (Fuente: Brooks et al., 2006).

Biodiversity Hotspots (BH).

Los puntos calientes de biodiversidad , o Biodiversity Hotspot (en adelante BH) son las reservas con mayor riqueza de especies de animales y plantas y los más amenazados de la Tierra (Conservation International,2005).

Para establecer prioridades para los programas de conservación, el Centro Mundial de Seguimiento de la Conservación, Birdlife Internacional, Conservation Internacional y otras organizaciones han identificado estas áreas clave del mundo con una elevada diversidad biológica y un alto nivel de endemismos y que se hallan en peligro inminente de extinción de especies.

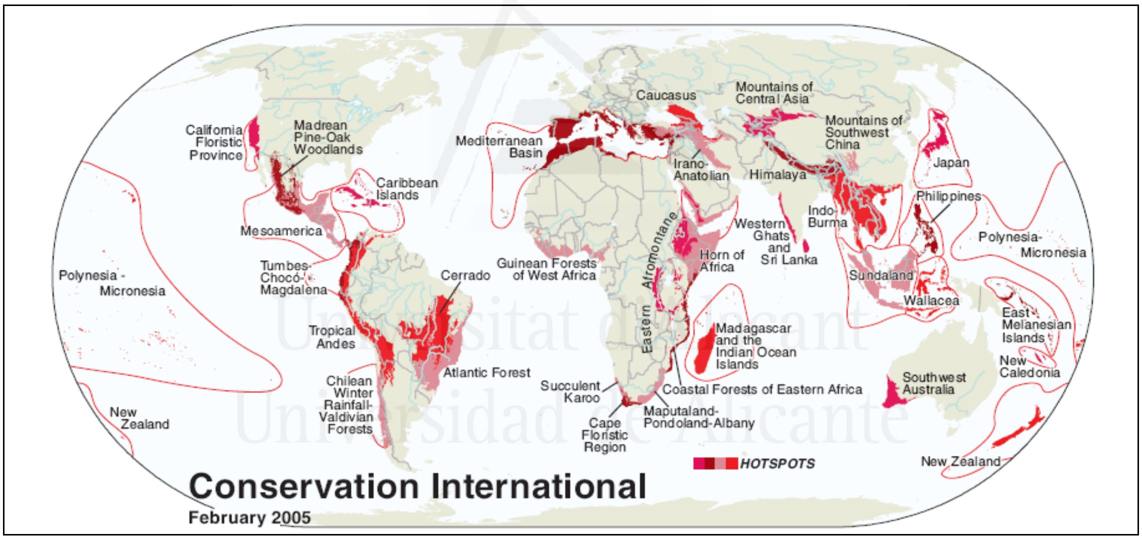


Figura 6. Biodiversity Hotspots (Fuente: Conservation International, 2005).

La primera aproximación fue realizada por Mittermeier et al. (1999). Identificaron 25 puntos calientes globales, que conjuntamente engloban las áreas de distribución del 44% de las especies de plantas del mundo, el 28% de las especies de aves, el 30 % de las especies de mamíferos, el 38% de las especies de reptiles y el 54 % de las especies de anfibios en tan sólo el 1.4% de la superficie total emergida de la Tierra. La última actualización realizada por Conservation Internacional contempla 39 BH (figura 5; tabla 1) y fue revisada en el año 2005.

North and Central America	**Europe and Central Asia**	**Asia-Pacific**	**South America**	**Africa**
California Floristic Province Caribbean Islands Madrean Pine-Oak Woodlands Mesoamerica	Caucasus Irano-Anatolian Mediterranean Basin Mountains of Central Asia	East Melanesian Islands Himalaya Indo-Burna Japan Mountains of Southwest China New Caledonia New Zealand Philippines Polynesia-Micronesia Sothwest Australia Sundaland Wallacea Western Ghats and Sri Lanka	Atlantic Forest Cerrado Chilean Winter Rainfall-Caldivian Forests Tumbes-Chocó-Magdalena Tropical Andes	Cape Floristic Region Coastal Forests of Eastern of Africa Eastern Afromontane Guinean Forests of West Africa Madagascar and the Indian Ocean Islands Maputaland-Pondoland-Albany Succulent Karoo

Tabla 4. Biodiversity Hotspots Regions (Fuente: CI, 2001).

Global 200 Ecoregions (G200).

Global 200 de WWF, es un primer intento de identificar un conjunto de ecoregiones cuya conservación lograría el objetivo de preservar una enorme diversidad de los ecosistemas terrestres (Figura 7). Estas ecoregiones incluyen excepcionales niveles de biodiversidad, como una gran riqueza de especies ó endemismos, ó fenómenos ecológicos ó evolutivos inusuales. Por esta razón Global 200 intenta representar toda la biodiversidad mundial, identificando ecoregiones de todos los biomas y regiones biogeográficas del mundo (Tabla 5).

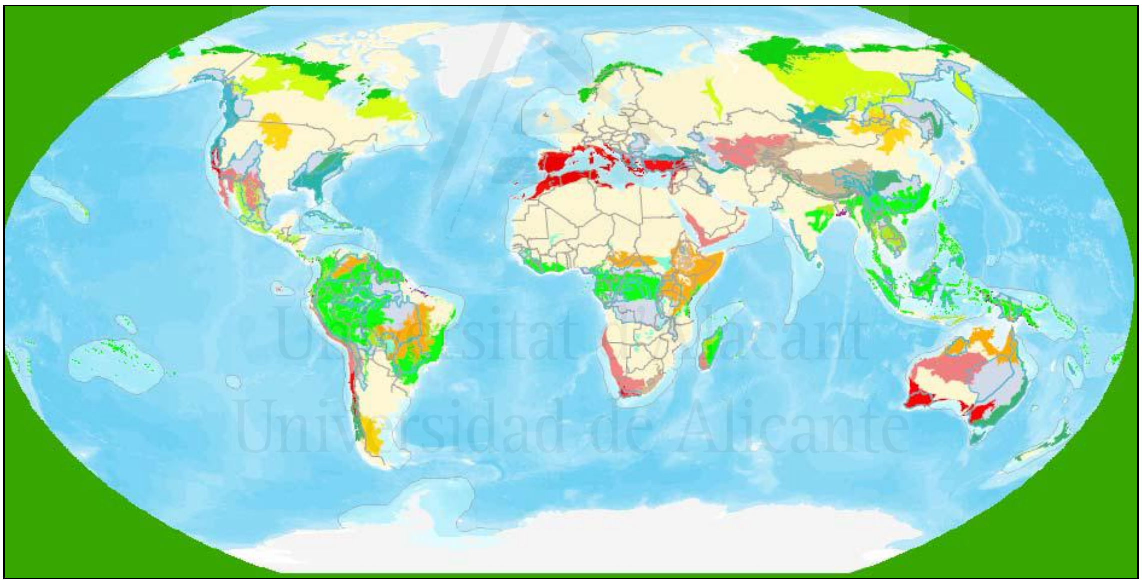


Figura 7. Ecoregiones Global 200 WWF (Fuente:WWF, 2001) .

TROPICAL AND SUBTROPICAL MOIST BROADLEAF FORESTS

Afrotropical
1. Guinean Moist Forest CE
2. Congolian Coastal Forests CE
3. Cameroon Highland Forests CE
4. Northeastern Congo Basin Moist Forests V
5. Central Congo Basin Moist Forests RS
6. Western Congo Basin Moist Forests V
7. Albertine Rift Montane Forests CE
8. East African Coastal Forests CE
9. Eastern Arc Montane Forests CE
10. Madagascar Forests and Shrublands CE
11. Seychelle and Mascarene Moist Forests CE

Australasian
12. Sulawesi Moist Forests CE
13. Moluccas Moist Forests V
14. Southern New Guinea Lowland Forests V

Savannas RS
15. New Guinea Montane Forests RS
16. Solomons-Vanuatu-Bismarck Moist Forests V
17. Queensland Tropical Forests V
18. New Caledonia Moist Forests CE
19. Lord Howe–Norfolk Islands Forests CE

Indo-Malayan
20. Southwestern Ghats Moist Forests CE
21. Sri Lankan Moist Forests CE ***Nearctic***
22. Northern Indochina Subtropical Moist Forests V
23. Southeast China-Hainan Moist Forests CE
24. Taiwan Montane Forests V
25. Annamite Range Moist Forests V
26. Sumatran Islands Lowland and Montane Forests CE
27. Philippine Moist Forests CE
28. Palawan Moist Forests CE
29. Kayah-Karen/Tenasserim Moist Forests V
30. Peninsular Malaysian Lowland and Montane Forests V
31. Borneo Lowland and Montane Forests CE
32. Nansei Shoto Archipelago Forests CE CE
33. Eastern Deccan Plateau Moist Forests CE
34. Naga-Manupuri–Chin Hills Moist Forests V
35. Cardamom Mountains Moist Forests RS
36. Western Java Montane Forests CE

Neotropical
37. Greater Antillean Moist Forests CE

BOREAL FORESTS/TAIGA

Nearctic
81. Muskwa/Slave Lake Boreal Forests RS
82. Canadian Boreal Forests RS

Palearctic
83. Ural Mountains Taiga V
84. Eastern Siberian Taiga RS
85. Kamchatka Taiga and Grasslands RS

TROPICAL AND SUBTROPICAL GRASSLANDS, SAVANNAS AND SHRUBLANDS

Afrotropical
86. Horn of Africa Acacia Savannas V
87. East African Acacia Savannas V
88. Central and Eastern Miombo Woodlands V
89. Sudanian Savannas CE

Australasia
90. Northern Australia and Trans-Fly

Indo-Malayan
91. Terai-Duar Savannas and Grasslands CE

Neotropical
92. Llanos Savannas V
93. Cerrado Woodlands and Savannas V

TEMPERATE GRASSLANDS, SAVANNAS

94. Northern Prairie CE
* Tallgrass prairies

Neotropical
95. Patagonian Steppe CE

Palearctic
96. Daurian Steppe V

FLOODED GRASSLANDS AND SAVANNAS

Afrotropical
97. Sudd-Sahelian Flooded Grasslands and Sav
98. Zambezian Flooded Savannas V

Indo-Malayan
99. Rann of Kutch Flooded Grasslands CE

Neotropical
100. Everglades Flooded Grassland V
101. Pantanal Flooded Savannas CE

* (Lesser Antillean Moist Forests) CE
38. Talamancan-Isthmian Pacific Forests RS

39. Choco´–Darie´n Moist Forests RS
40. Northern Andean Montane Forests CE
41. Coastal Venezuela Montane Forests V
42. Guianan Moist Forests RS
43. Napo Moist Forests V

44. Rio Negro-Jurua´ Moist Forests CE
45. Guayanan Highland Moist Forests RS
46. Central Andean Yungas CE
47. Southwestern Amazonian Moist Forests RS
48. Atlantic Forests CE

Oceania

49. South Pacific Island Forests CE
50. Hawaii Moist Forests CE

Paleartic

TROPICAL AND SUBTROPICAL DRY BROADLEAF FORESTS

Afrotropical

51. Madagascar Dry Forests CE

Australasia

52. Nusa Tenggara Dry Forests CE
53. New Caledonia Dry Forests CE

Indo-Malayan

54. Indochina Dry Forests CE
55. Chhota-Nagpur Dry Forests CE

Neotropical

56. Mexican dry Forests CE
57. Tumbesian-Andean Valleys Dry Forests CE
58. Chiquitano Dry Forests CE
59. Atlantic Dry Forests CE

Oceania

60. Hawaii Dry Forests CE

Australasia

TROPICAL AND SUBTROPICAL CONIFEROUS FORESTS

Nearctic

61. Sierra Madre Oriental and Occidental Pine-Oak Forests CE

Neotropical

62. Greater Antillean Pine Forests CE
63. Mesoamerican Pine-Oak Forests CE

TEMPERATE BROADLEAF AND MIXED FORESTS

Australasia

64. Eastern Australia Temperate Forests CE
65. Tasmanian Temperate Rain Forests V
66. New Zealand Temperate Forests V
125. Madagascar Spiny Thicket CE

Indo-Malayan

67. Eastern Himalayan Broadleaf and Conifer

MONTANE GRASSLANDS AND SHRUBLANDS

Afrotropical

102. Ethiopian Highlands CE
103. Southern Rift Montane Woodlands CE
104. East African Moorlands RS

105. Drakensberg Montane Shrublands and Wood CE

Australasia

106. Central Range Subalpine Grasslands RS

Indo-Malayan

107. Kinabalu Montane Shrublands RS

Neotropical

108. Northern Andean Paramo RS
109. Central Andean Dry Puna V

110. Tibetan Plateau Steppe V
111. Middle Asian Montane Steppe and W. V
112. Eastern Himalayan Alpine Meadows RS

TUNDRA

Nearctic

113. Alaskan North Slope Coastal Tundra RS
114. Canadian Low Arctic Tundra RS

Palearctic

115. Fenno-Scandia Alpine Tundra and TaigaV

116. Taimyr and Siberian Coastal Tundra RS
117. Chukote Coastal Tundra RS

MEDITERRANEAN FORESTS, WOODL.,SCRUB

Afrotropical

118. Fynbos CE

119. Southwestern Australia Forests Scrub CE

120. Southern Australia Mallee Woodlands CE

Nearctic

121. California Chaparral and Woodlands CE

Neotropical

122. Chilean Matorral CE

Palearctic

123. Mediterranean Forests, Woodlands, and Scrub CE

DESERTS AND XERIC SHRUBLANDS

Afrotropical

124. Namib-Karoo-Kaokoveld Deserts V

126. Socotra Island Desert CE
127. Arabian Highland Woodlands and

Forests V
68. Western Himalayan Temperate Forests CE
Nearctic
69. Appalachian and Mixed Mesophytic Forests V
Palearctic
70. Southwest China Temperate Forests V
71. Russian Far East Temperate Forests V

TEMPERATE CONIFEROUS FORESTS
Nearctic
72. Pacific Temperate Rainforests CE
73. Klamath-Siskiyou Coniferous Forests CE
74. Sierra Nevada Coniferous Forests CE
75. Southeastern Coniferous and Broadleaf Forests CE
Neotropical
76. Valdivian Temperate Rainforests/Juan Ferna ´ndez Islands CE
* (Juan Ferna´ndez Islands and Desventuradas Islands) CE
Palearctic
77. European-Mediterranean Montane Mixed Forests CE
78. Caucasus-Anatolian-Hyrcanian Temperate Forests CE
79. Altai-Sayan Montane Forests V
80. Hengduan Shan Coniferous Forests RS

Shrublands V
Australasia
128. Carnavon Xeric Scrub CE
129. Great Sandy-Tanami Deserts RS
Nearctic
130. Sonoran-Baja Deserts RS
131. Chihuahuan-Tehuaca´n Deserts V
Neotropical
132. Galápagos Islands Scrub V
133. Atacama-Sechura Deserts V
Palearctic
134. Central Asian Deserts CE

MANGROVES
Afrotropical Atlantic
135. Gulf of Guinea Mangroves CE
Afrotropical Indian
136. East African Mangroves CE
137. Madagascar Mangroves CE
Australasia
138. New Guinea Mangroves RS
Indo-Malayan Indo-Pacific
139. Sundarbans Mangroves CE
140. Greater Sundas Mangroves CE
Neotropical Atlantic
141. Guianan–Amazon Mangroves RS
Neotropical Pacific
142. Panama Bight Mangroves RS

Tabla 5. Ecoregiones Global 200 terrestres, organizadas por biomas y por regiones biogeográficas (Fuente: Olson and Dinerstein, 2002).

Last of the Wild (LW).

La influencia del hombre en la superficie de la Tierra ha sido una constante en los procesos ecológicos del planeta, junto con los cambios climáticos, fuerzas geológicas y variaciones astronómicas. Wildlife Conservation Society (WCS),Center for Internacional Herat Science Information Network (CIESIN) y la Universidad de Columbia han realizado de manera conjunta un mapa en el que se mide la influencia humana en la superficie terrestre en la actualidad. Este análisis indica que el 83% de la superficie terrestre está influida directamente por actuaciones humanas, bien a través de uso de la tierra, carreteras, infraestructuras ferroviarias ó embalses, infraestructuras eléctricas ó con indicadores de ocupación directa por el hombre con densidades de 1 persona/km^2. La influencia del hombre sobre la superficie terrestre se ha medido como "Human Footprint". Aproximadamente se ha estimado un 17% de la superficie de la Tierra mínimamente afectada por las actividades humanas, con una baja densidad de población humana y que no es probable que se exploten económicamente en un futuro, por tanto, ofrecen interesantes oportunidades para la conservación. Estas áreas, que se encuentran identificadas por biomas, son "Last of the Wild"(Figura 8).

A través del análisis de la "huella humana", se han identificado 569 "wild places", que representan las áreas sin modificar más grandes en cada uno de los biomas del mundo. Aunque estos lugares varían mucho en su productividad y diversidad biológica, representan las áreas menos modificadas o más "salvajes" en cada bioma.

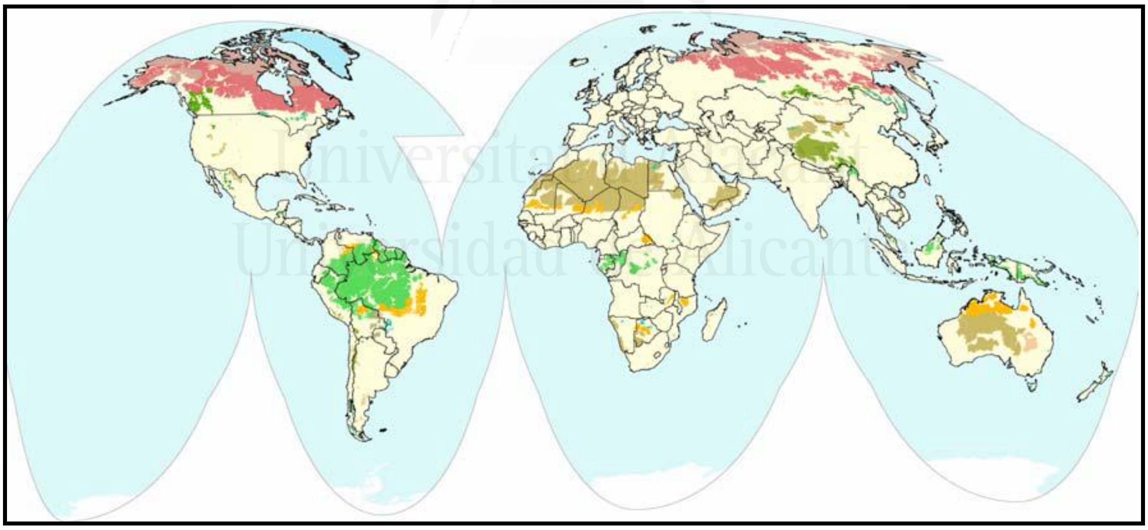


Figura 8. Last of the Wild (Fuente: CIESIN, 2006).

En la tabla 6 se presenta información sobre la superficie y el número de LW, por biomas y por regiones biogeográficas:

REGIONES BIOGEOGRÁFICAS	BIOMAS	SUPERFICIE (Km)	Last of the Wild
Australasia	Tropical and Subtropical Moist Broadleaf Forests	16413.43	10
	Montane Grasslands and Shrublands	2384.76	0
	Mediterranean Forests, Woodlands and Scrub	73310.16	0
	Deserts and Xeric Shrublands	83062.73	10
	Mangroves	42.61	10
	Tropical and Subtropical Dry Broadlef Forests	1682.67	10
	Temperate Broadlef and Mixed Forests	81183.93	10
	Tropical and Subtropical Grasslands, Savannas and Shrublands	69911.62	10
	Temperate Grasslands, Savannas and Shrublands	38766.99	10
Afrotropics	Tropical and Subtropical Moist Broadleaf Forests	136084.54	10
	Montane Grasslands and Shrublands	49945.09	10
	Mediterranean Forests, Woodlands and Scrub	7035.01	10
	Deserts and Xeric Shrublands	117056.70	10
	Mangroves	3469.29	10
	Tropical and Subtropical Dry Broadlef Forests	7682.43	10
	Tropical and Subtropical Grasslands, Savannas and Shrublands	680358.34	10
	Temperate Grasslands, Savannas and Shrublands	1600.91	5
	Flooded Grasslands and Savannas	16632.54	10
Indo-Malay	Tropical and Subtropical Moist Broadleaf Forests	276715.90	10
	Montane Grasslands and Shrublands	141.91	2
	Deserts and Xeric Shrublands	94956.06	8
	Mangroves	4755.96	7
	Tropical and Subtropical Dry Broadlef Forests	124695.84	10
	Tropical and Subtropical Coniferous Forests	5874.11	3
	Temperate Broadleaf and Mixed Forests	5454.58	10
	Temperate Conifer Forests	3662.52	10
	Tropical and Subtropical Grasslands, Savannas and Shrublands	3883.51	10
	Flooded Grasslands and Savannas	752.52	10
	Snow and Ice	302.90	0
Neartic	Tundra	5951.64	10
	Mediterranean Forests, Woodlands and Scrub	9933.54	10
	Deserts and Xeric Shrublands	147828.89	10
	Mangroves	105.91	6
	Tropical and Subtropical Dry Broadlef Forests	4983.94	10
	Tropical and Subtropical Coniferous Forests	7434.64	10
	Temperate Broadleaf and Mixed Forests	231734.51	10
	Temperate Conifer Forests	125501.28	10
	Boreal Forests/Taiga	46053.17	10
	Tropical and Subtropical Grasslands, Savannas and Shrublands	6501.84	10
	Flooded Grasslands and Savannas	293476.61	10
	Snow and Ice	5.16	10
Neotropics	Tropical and Subtropical Moist Broadleaf Forests	191111.29	10
	Montane Grasslands and Shrublands	32539.37	10
	Mediterranean Forests, Woodlands and Scrub	10220.67	10
	Deserts and Xeric Shrublands	83585.23	10
	Mangroves	5487.32	10
	Tropical and Subtropical Dry Broadlef Forests	116487.09	10
	Tropical and Subtropical Coniferous Forests	23941.15	10
	Temperate Broadleaf and Mixed Forests	13654.39	10
	Tropical and Subtropical Grasslands, Savannas and Shrublands	145769.60	10
	Temperate Grasslands , Savannas and Shrublands	107579.75	10
	Flooded Grasslands and Savannas	16626.28	10
	Snow and Ice	0.00	3
Paleartic	Tropical and Subtropical Moist Broadleaf Forests	25810.81	4
	Montane Grasslands and Shrublands	100332.92	10
	Tundra	35776.69	10
	Mediterranean Forests, Woodlands and Scrub	179053.17	10
	Deserts and Xeric Shrublands	523348.46	10
	Temperate Broadleaf and Mixed Forests	785048.29	10
	Temperate Conifer Forests	72224.12	10
	Boreal Forests/Taiga	279664.60	10
	Temperate Grasslands , Savannas and Shrublands	368349.19	10
	Flooded Grasslands and Savannas	24023.82	10
	Snow and Ice	475.99	10

Tabla 6. Last of the Wild (Fuente: CIESIN, 2006).

2.INSTITUCIONES Y BUEN GOBIERNO.

2.1. El Enfoque Institucional. Instituciones para el gobierno de los comunes.

El concepto de gobierno ha sido estudiado desde las ciencias sociales inicialmente y más tarde desde las ciencias ambientales. Sin embargo, la definición de los conceptos "gobierno ambiental" y "gobierno social", sugieren dos enfoques independientes de estudiar el gobierno.

El buen gobierno entendido desde una perspectiva socio-económica descansa sobre el concepto de calidad institucional. Para entender esta relación a continuación se describen brevemente algunos aspectos de la nueva economía institucional.

La nueva economía institucional es una escuela de pensamiento que se caracteriza por dos rasgos principales: la incorporación de los derechos de propiedad en el análisis económico y la introducción de los "costes de transacción" (San Emeterio,2006). La Teoría de la Acción Colectiva se refiere al análisis de los derechos de propiedad y aparece vinculada al concepto de "bien público". Estas teorías tratan de determinar los resultados colectivos en términos de las motivaciones individuales (Garcimartín and Alonso, 2008). Los principales trabajos sobre la lógica de la acción colectiva son los que plantearon Olson (1965), Hardin (1968) y Ostrom (1990).

Olson (1965) mantiene el pesimismo sobre la gestión sostenible de los recursos comunes y basándose en un análisis comparado de costes y beneficios marginales asociados a la provisión del bien colectivo llega a tres conclusiones principales: (i) las dificultades que tienen los grandes grupos para articular una acción colectiva racional (ii)las mayores posibilidades de respuesta colectiva que tienen los grupos pequeños y heterogéneos (iii)la tendencia de estos grupos heterogéneos a que los miembros más pequeños se aprovechen del mayor interés que los grandes tienen en la provisión del bien. En síntesis, Olson explica "el fallo de la acción colectiva" cuando los agentes se revelan incapaces de articular sus acciones para obtener el resultado compartidamente deseado (Garcimartín and Alonso, 2008).

La Tragedia de los Comunes planteada por Hardin en 1968 plantea que un usuario "racional" de bienes comunes demanda recursos hasta que sus beneficios esperados se igualan a los costes esperados. Como cada usuario ignora los costes impuestos sobre los otros, las decisiones individuales se acumulan hasta un trágico sobre-uso y la potencial destrucción de los comunes de libre acceso. Esta teoría sostiene que es inevitable la destrucción de los recursos comunes, como los recursos naturales por los propios usuarios.

Sin embargo Ostrom (1990) ofrece una visión más optimista sobre el éxito de la acción colectiva y sostiene que, aunque el problema del comportamiento del *free-rider* en los recursos comunes es universal, en determinadas condiciones, los agentes son capaces de organizarse y de establecer sistemas de gobierno sobre los recursos sostenibles, de modo que los participantes invierten recursos en monitorear y sancionar las acciones del resto para reducir la probabilidad de *free riding*.

Estas teorías explican el comportamiento de los agentes sociales estrechamente vinculado a las instituciones, entendidas estas como las reglas del juego existentes en una sociedad que dan forma a la interacción humana (North,1994; Ostrom,1990).

El marco institucional en el que se desarrollan las interacciones entre agentes sociales y económicos es el mismo en el que se ubican los sistemas sociales y ecológicos (Janssen and Anderies, 2007) como los espacios protegidos. Por tanto, conviene cuanto menos revisar el concepto y los principios que definen el buen gobierno desde un enfoque socio-económico.

2.2.El gobierno y el buen gobierno.

El Banco Mundial define Gobierno como las tradiciones e instituciones por las que se ejerce la autoridad en un país para los bienes comunes. Esto incluye: i)el proceso por el cual se realiza la selección, seguimiento y reemplazamiento de la autoridad ii) la capacidad del gobierno de gestionar eficazmente sus recursos y de implementar políticas iii) el respeto de los ciudadanos y del Estado para las instituciones que gobiernan las interacciones económicas y sociales entre ellos.

La Organización para la Cooperación Económica y el Desarrollo (OCDE) señala que un Buen Gobierno público debe ayudar a fortalecer la democracia y los derechos humanos, promover la prosperidad económica y la cohesión social, reducir la pobreza, lograr la protección ambiental y el uso sostenible de los recursos naturales y ofrecer confianza en el gobierno y la administración pública.

Otra definición de "gobernanza" que otorga gran importancia al contexto de democracia es el de Foucalt, que se identifica con las relaciones entre instituciones y participación ciudadana .

En definitiva, en todas ellas, se considera una estructura, más ó menos compleja de relaciones de poder entre los agentes sociales para la toma de decisiones.

El Banco Mundial define los principios de buen gobierno que se muestran en la tabla 7. Transparencia Internacional, el World Economic Forum y la Heritage Foundation han desarrollado indicadores que contribuyen a medir la calidad de las instituciones, como el Índice de Percepción de la Corrupción (Transparency International ,2011) , el Índice de Competitividad Global (World Economic Forum, 2011) y el Índice de Libertad Económica (Heritage Foundation, 2011).

PRINCIPIOS DE BUEN GOBIERNO DEL BANCO MUNDIAL
Voz y Rendición de Cuentas
Estabilidad Política
Eficacia del Gobierno
Calidad de la Regulación
Estado de Derecho
Control de la Corrupción

Tabla 7. Principios de buen gobierno del Banco Mundial (Fuente: World Bank, 2010).

Desde principios de los noventa aparece una nueva forma de concebir el futuro , "evolución vs desarrollo" que se centra en la evolución de las poblaciones, es decir a la preocupación por la educación, la protección de la salud, la cultura y la identidad propia sobre el desarrollo puramente económico.

Parece necesario revisar la "forma de hacer gobierno", especialmente en aspectos como la corrupción, los derechos humanos y la descentralización (Human Development Report 1990,PNUD). En la década de los 90 se adoptan nuevos Compromisos Internacionales sobre Desarrollo Humano como los Objetivos de Desarrollo del Milenio que subrayan la necesidad de mejorar el gobierno en todos sus niveles como condición necesaria para erradicar la extrema pobreza y el hambre, garantizar una educación primaria universal, promover la igualdad de género y el emponderamiento de la mujer, reducir la mortalidad infantil, mejorar la salud maternal , combatir el HIV/AIDS, la malaria y otras enfermedades y asegurar la sostenibilidad ambiental (UNDP,2011). Estas declaraciones institucionales son el fruto de intensas negociaciones políticas (Hulme and Scott, 2010) y son un claro ejemplo de cómo el funcionamiento del gobierno internacional plantea retos globales que deben afrontarse diseñando modelos de gobierno eficientes desde contextos específicos. La vinculación entre sistemas sociales y sistemas ecológicos cada vez es más fuerte y resulta imposible desligar unos de otros. El gobierno en las áreas protegidas forman parte del marco institucional que acabamos de describir y para diseñarla adecuadamente es preciso definir un único concepto transversal de gobierno.

2.3. El gobierno y el buen gobierno en las áreas protegidas.

Graham et al. (2003) definen "gobernanza" como "las interacciones entre estructuras, procesos y tradiciones que determinan cómo se ejercen el poder y las responsabilidades, cómo se toman las decisiones y cómo participan los ciudadanos y otros agentes implicados ". Esta definición es la que toman como base para definir el gobierno en áreas protegidas. Por otro lado, Abrams et al.(2003) sostienen que la principal función del buen gobierno en áreas protegidas es crear y mantener las condiciones necesarias para una gestión eficiente.

Graham et al.(2003) definen los principios de buen gobierno en áreas protegidas en base a los principios de buen gobierno de las Naciones Unidas como muestra la tabla 8.

PRINCIPIOS DE BUENA GOBERNANZA	PRINCIPIOS UNDP EN LOS QUE SE BASAN
Legitimidad y voz	Participación Orientación al consenso
Dirección	Visión estratégica, incluyendo desarrollo humano y complejidades históricas, culturales y sociales
Rendimiento	Responsabilidad de las instituciones y procesos para los stakeholders Eficacia y eficiencia
Rendición de cuentas	Rendición de cuentas al público y a los stakeholders institucionales Transparencia
Justicia	Equidad Reglas del juego

Tabla 8.Principios de buen gobierno en áreas protegidas basados en UNDP (Fuente: Graham et al., 2003).

Lockwood (2010) incorporó algunas modificaciones sobre estos principios, que se muestran en la tabla 9.

PRINCIPIOS DE BUENA GOBERNANZA EN ÁREAS PROTEGIDAS PARA LOCKWOOD,2010
Legitimidad
Transparencia
Rendición de cuentas
Inclusividad
Justicia
Conectividad
Resiliencia

Tabla 9 .Principios de buen gobierno en áreas protegidas (Fuente: Lockwood, 2010).

Hasta la fecha estos son los principios de buen gobierno en áreas protegidas que se han propuesto. En la última década el buen gobierno de las áreas protegidas ha adquirido una creciente importancia en la comunidad científica y en la sociedad. El Convenio de Diversidad Biológica (CBD) en la última Conferencia de las Partes ha subrayado la necesidad de realizar estudios en profundidad para mejorar el gobierno en áreas protegidas, siguiendo las directrices del plan de trabajo de la Estrategia 2011-2020 para reducir la pérdida de biodiversidad (11 CP-CBD,2012). Sin embargo, todavía no se han incluído suficientemente algunos aspectos de buen gobierno relacionados con un enfoque institucional en las áreas protegidas.

3.TÉCNICAS MULTI-CRITERIO EN GESTIÓN DE RECURSOS NATURALES.

3.1. El análisis de decisiones multi-criterio (MCDA). Concepto y clasificación.

La decisión multi-criterio debe entenderse como un proceso en el que intervienen numerosos elementos, entre ellos los múltiples puntos de vista en conflicto entre sí . El decisor se encuentra en disposición de escoger entre varias posibilidades ó *alternativas*, el conjunto de las cuales constituye el *conjunto de elección*. Para escoger en este conjunto de elección el decisor tiene varios puntos de vista, denominados *criterios*. Estos criterios son, al menos parcialmente contradictorios, en el sentido que si el decisor adopta uno de estos puntos de vista, no escogerá la misma alternativa que si se basa en

otro criterio (Lara, 1991).En este contexto, Fernández and Escribano (2013) definen el análisis de decisión multi-criterio como "una actividad que ayuda a tomar decisiones, principalmente en términos de elección, ordenación y clasificación de alternativas".
Otra definición de análisis de decisión multi-criterio (MCDA) es propuesta por Belton and Stewart (2002) como "un término que aglutina un conjunto de enfoques formales que consideran explícitamente múltiples criterios y que sirven de ayuda para la toma de decisiones individuales ó en grupo". Estas técnicas permiten integrar el comportamiento de los objetivos con los juicios de valor del decisor ó decisores, cuantificando esa subjetividad (Maroto et al., 2012).

Existen varias clasificaciones de los métodos MCDA. Una de las clasificaciones más ampliamente empleadas es la que se basa en el número de alternativas y distingue entre Técnicas Multi-atributo y Técnicas Multi-objetivo (Belton and Stewart,2002; Figueiras et al.,2005; Korhonen et al.,1992; Mendoza et al.,2006). Las primeras utilizan valores discretos y obtienen un ranking de alternativas. Para ello se puede emplear un método de comparación por pares o se pueden utilizar funciones de valor. Las Técnicas Multi-objetivo son modelos contínuos y utilizan técnicas de optimización como programación lineal y geométrica o técnicas de optimización para seleccionar la mejor alternativa posible. Estos modelos también son denominados modelos "abiertos", en el sentido de que no establecen a priori el número de alternativas (Romero, 1993). Los métodos multi-atributo ó discretos son aquellos que trabajan con un número finito de alternativas. El número de alternativas puede variar dependiendo de cómo se desee obtener la solución del problema.

Las técnicas multi-criterio discretas ó técnicas multi-atributo más utilizadas son :

Analytical Hierarchy Process (AHP): Método multi-criterio desarrollado por Saaty en 1982 y característico de la Escuela Americana. AHP usa una comparación por pares para obtener la importancia relativa de los criterios y de las alternativas, sobre una estructura jerárquica del problema de decisión. Este método permite cuantificar la importancia de los criterios y objetivos, así como priorizar las alternativas de gestión.

Una de las ventajas de AHP es que no precisa información cuantitativa acerca del resultado que alcanza cada alternativa en cada uno de los criterios considerados, sino solamente los juicios de valor del decisor (Romero,1993). Sin embargo, al trabajar con juicios de valor, es necesario comprobar que los resultados obtenidos son consistentes. Aunque el uso de AHP ha recibido algunas críticas derivadas del problema de reversibilidad del ranking fundamentalmente (Bana e Costa and Vansnick, 2008), este es uno de los métodos que más se ha utilizado para desarrollar trabajos empíricos.

Analytical Network Process (ANP): Es una generalización de AHP, sin embargo la estructura base no es jerárquica sino en forma de redes. Las prioridades se establecen de la misma forma que con AHP usando comparaciones por pares y juicios de valor (Saaty,2001) .

Multiattributte Value Theory (MAVT): MAVT obtiene funciones de valor para cada criterio y posteriormente, estas funciones individuales se agregan en una función de valor global. Sin embargo, nos encontramos de nuevo con las limitaciones que supone el empleo de formas aditivas de agregación y por otro lado el número de criterios no debe ser muy alto. Su aplicación resulta más compleja que la desarrollada por AHP pero igualmente es una de las técnicas más empleadas en gestión de recursos naturales

Multi-attributte Utility Theory (MAUT): MAUT se basa en la teoría de la utilidad esperada, que asume que cada criterio se asocia directamente con un atributo cuantitativo medido en escala cardinal (Belton and Stewart,2002). Este método utiliza de manera similar a MAVT funciones de utilidad para cada criterio, agregándolas posteriormente en una función de utilidad global. Estas funciones de utilidad tiene que cumplir "que una alternativa ***a*** será preferida a otra alternativa ***b*** si y sólo si la utilidad esperada de ***a*** es mayor que la utilidad esperada de ***b***" (Durbach and Stewart,2012). Al igual que MAVT y que otras técnicas compensatorias, MAUT evalúa el proceso bajo asunciones de sostenibilidad débil, con las limitaciones derivadas de la aditividad. La diferencia fundamental respecto de MAVT es que se utiliza en condiciones de incertidumbre, de manera que mientras MAVT define funciones de valor, MAUT define funciones de probabilidad.

Simple Multi-attributte Rating Technique-SMART es una versión más sencilla de MAUT, y se basa también en los principios de la teoría de la utilidad. Esta técnica puede ser combinada con otras técnicas no compensatorias. Reynolds (2001) utiliza este análisis para priorizar proyectos de restauración de hábitats para el salmón, utilizando

SMART y AHP ; de manera que obtiene los pesos sobre los criterios con AHP, y el ranking de alternativas utilizando SMART.

ELimination Et Choix Traduisant la REalité (ELECTRE): Es una Técnica Outranking ó de superación de la Escuela Francesa desarrollada por Roy en 1968. ELECTRE define el ranking de alternativas en base a relaciones de sobreclasificación. El Método ELECTRE constituye un método iterativo de refinamiento de la solución basado en cuatro umbrales de juicio: indiferencia, preferencia fuerte, preferencia débil y veto (Roy, 1996). El ranking de las alternativas se obtiene comparando por pares los criterios y obteniendo la deseabilidad de cada alternativa utilizando un análisis de concordancia y discordancia. De esta forma, el valor de una alternativa viene determinado por el grado en que sus atributos están en acuerdo o desacuerdo con unos objetivos, criterios y restricciones predeterminados (Rudolphi and Haider, 2003).

PReference Ranking Organization METHod for Enrichment Evaluation (PROMETHEE). Es otra técnica outranking que utiliza comparaciones por pares y obtiene un ranking outranking de las alternativas. Se describe con detalle en el apartado de Métodos generales.

Las técnicas contínuas más empleadas son:

Linear Programming (LP): Incluye un objetivo que debe ser maximizado o minimizado, considerando el resto de objetivos como restricciones (Myllyviita et al.,2011).

Goal Programming (GP): La Programación por Metas formaliza el concepto "satisfacción" y requiere una medida de la "distancia" o discrepancia del objetivo (Ananda and Herath., 2009)

Compromise Programming (CP): Este método provee soluciones cercanas al óptimo sin garantizar la factibilidad ó la optimalidad de los resultados (Myllyviita et al., 2011).

Otros métodos:

Fuzzy Methods: Los métodos basados en la lógica difusa incorporan la incertidumbre derivada de la imprecisión y a la información imperfecta. Este enfoque especifica cada alternativa usando funciones vinculadas (Ananda and Herath.,2009).

Soft systems methods: Son métodos poco o nada estructurados basados en la participación en grupo y dan prioridad a la definición de factores más relevantes, perspectivas y cuestiones que deben tenerse en cuenta. También sobre el diseño de estrategias para que el problema sea mejor comprendido y el proceso de toma de decisiones mejor orientado (Mendoza and Martins. ,2006).

3.2. La Decisión Multi-criterio y la Gestión de Áreas Protegidas.

Cuando hablamos de toma de decisiones en áreas protegidas, es necesario introducir el concepto de *agente ó "stakeholder"*. "***Stakeholder"*** (en adelante agente) es alguien que resulta afectado o puede afectar a una situación de algún modo; es decir, los agentes son las partes interesadas en un problema de decisión (Nordstrom et al., 2010). En el caso de las áreas protegidas, generalmente los agentes suelen ser los propietarios de las tierras, empresas privadas que desarrollan su actividad en ese territorio, asociaciones locales, organizaciones ecologistas, entidades gubernamentales y agencias gestoras y usuarios de los recursos en general.

La definición de área protegida conlleva una serie de restricciones respecto al uso de los recursos naturales. Estas restricciones han supuesto y suponen fuertes conflictos de interés entre las poblaciones locales y otros agentes vinculados directa e indirectamente al área protegida. De esta forma la competencia entre conservación y uso de los recursos naturales adquiere especial protagonismo y supone un grave problema.

El incremento de la superficie, el número y la diversidad de áreas protegidas en las últimas décadas junto con la vulnerabilidad de sus ecosistemas, ha generado la necesidad de disponer de modelos de gestión no sólo eficientes, sino que tengan en cuenta la participación pública de todos los actores involucrados. De esta forma, los procesos de toma de decisiones en las áreas protegidas ha adoptado un enfoque diferente en los últimos años. Por una parte, se ha otorgado una mayor participación de las comunidades locales, descentralizando el modelo de gobierno e incorporando nuevos agentes a los procesos de toma de decisiones. Por otra, aparece una fuerte tendencia a la gestión colaborativa entre comunidades locales y entidades gubernamentales, se ha fomentado un mayor uso de mecanismos formales de rendición de cuentas, se han producido numerosos cambios legislativos y políticos y una mayor implicación del sector privado y en general se dispone de un mayor montante de fondos, provenientes de una mayor diversidad de fuentes (Dearden et al., 2005; Kothari, 2008). Esta nueva situación requiere desarrollar herramientas con capacidad para estructurar de manera ordenada los procesos de toma de decisiones que aseguren su eficiencia y con capacidad para proporcionar la transparencia, equidad y representatividad que asegure la confianza de los agentes en la gobierno del área protegida.

Las técnicas de Análisis Multi-criterio han mostrado ser una herramienta de gran operatividad, desempeñando un papel importante en la toma de decisiones relacionadas con la gestión de los recursos naturales, fundamentalmente en problemas relacionados con la gestión forestal y con la gestión del agua (Ananda and Herath, 2009;Diaz-Balteiro and Romero,2008; Mendoza and Martins,2006;Weintraub et al.,2005). En particular, la Toma de Decisiones Multi-atributo resultan particularmente útil para resolver conflictos de intereses, como los relacionados con la gestión de los recursos naturales en áreas protegidas , donde entran en conflicto intereses económicos, ecológicos y sociales (Hajkovicz, 2008; Marchamalo and Romero, 2007; Marshall et al., 2011; Prato, 2001). Estos métodos admiten técnicas participativas y proporcionan un marco estructurado de discusión que puede resultar de gran ayuda para resolver conflictos y optimizar recursos. Además aportan transparencia a los procesos de participación para la formulación de políticas públicas en gestión de recursos naturales (Ananda, 2007) y constituyen una interesante fuente de información para los gestores.

3.3. El Análisis de Decisión Multi-criterio y la Participación.

Las técnicas participativas son aquellas que incorporan varios decisores en el proceso de decisión. El valor de la participación reside en el concepto de “process losses”, que se refiere a “las pérdidas” en un proceso ocasionadas por la falta de comunicación del grupo (Schmoldt and Peterson, 2001).

Siguiendo este enfoque, las técnicas de análisis multi-criterio pueden clasificarse en técnicas participativas y no participativas, dependiendo de si sólo hay un decisor ó varios. Por otro lado las técnicas multi-criterio participativas pueden desarrollarse en términos colaborativos ó no, pudiendo adoptar diferentes grados de participación, en función de la intensidad de la interacción entre los decisores a lo largo del proceso.

Algunos ejemplos de técnicas participativas empleadas con frecuencia en toma de decisiones multi-criterio son los “focus group”, “workshops”, “votaciones” y “brain storming”. Una forma de participación de gran aceptación en los últimos años es la “evaluación deliberativa”, que combina varias formas de participación como los “focus group”, “citizen’s juries” ó “consensus conferences” (Marshall, 2011).

En gestión de recursos naturales el objetivo fundamental de la participación es incrementar la sostenibilidad social. Ésta a menudo se representa a través de atributos como empleo para poblaciones locales, status y condiciones de vida de población indígena ó simplemente, una participación más amplia en los procesos de planificación y una aceptación mayor de estos resultados (Hiltunen et al.,2009).

Sin embargo, para que un proceso participativo sea eficaz debe cumplir una serie de requisitos. Marshall (2011) identifica algunos retos importantes que deben superar las técnicas que incluyen la deliberación para la toma de decisiones: representatividad adecuada , aspectos potencialmente negativos de los grupos pequeños (que siempre hable la misma persona), el alcance de la deliberación debe estar bien definido y dirigido a lo largo del proceso, comprensión adecuada e interés de los participantes, confianza de los participantes en el proceso, facilitación vs consenso e incentivos de los gobiernos para apoyar el proceso de deliberación.

A pesar de estas limitaciones, parecen haber adquirido importancia técnicas que incorporan al análisis multi-criterio nuevas formas de participación con un mayor grado de colaboración, como Deliberative Multicriteria Evaluation (DMCE) y Decision Analysis Interview (DAI).

DMCE es una técnica que combina el análisis multi-criterio con procedimientos deliberativos y que permite estructurar los procesos de toma de decisiones y asegurar una interacción y deliberación efectiva para múltiples centros decisores (Proctor and

Drechsler, 2003). El objetivo principal es proveer de un marco estructurado para la toma de decisiones que tenga en cuenta las preferencias de los agentes. Es útil porque aporta una mejor comprensión del problema, información sobre los "trade offs" de los diferentes puntos de vista y también información sobre los diferentes impactos y resultados de las diferentes opciones.

DAI es un método multi-criterio que modela las preferencias de los agentes con un método de decisión analítica mediante entrevistas personales e interactivas entre el analista de la decisión y cada agente, y que utiliza un software interactivo para ponderar los atributos y analizar los resultados (Marttunen and Hamalainen, 1995). El resultado de la entrevista es discutido y analizado en reuniones entre los agentes, donde se ponen en común los resultados de las entrevistas y se negocian y discuten las preferencias obtenidas en el Análisis Multi-criterio.

La verdadera aportación de los MCDM en procesos participativos es que facilitan, no sólo una solución, sino sobre todo un proceso "caja de cristal" que aporta información a través de un proceso flexible a todos los participantes y que permite poner en común los diferentes enfoques (Hajkowicz, 2008).

MÉTODOS GENERALES Y OBJETIVOS

Pluvisilva (Camboya). Foto: V. Urios.

Los principales métodos que se han utilizado en cada sección de esta tesis doctoral son:

SECCIÓN I: Análisis de "lagunas de conservación" (Gap Analysis) con Sistemas de Información Geográfica (GIS): Es un análisis comparado entre las prioridades de la biodiversidad con las áreas protegidas actuales ó existentes (Olson and Dinerstein,1998; Scott and Csuti,1996). Los sistemas de información geográfica ofrecen la posibilidad de integrar una gran variedad de datos espaciales para su análisis ó visualización en mapas.

SECCIÓN II: La revisión bibliográfica se ha realizado mediante una búsqueda en revistas de impacto del Journal Citation Reports (Science and Social Science). Dado el carácter multidisciplinar de la investigación, la búsqueda se ha realizado en las siguientes áreas: Operations Research/Management Science, Biodiversity Conservation, Economics, Forestry, Environmental Sciences/Ecology, Agricultural Economics and Policy, Business and Statistics/ Probability .

SECCIÓN III: PReference Ranking Organization METHod for Enrichment Evaluation (PROMETHEE): es una técnica multi-criterio desarrollada por Brans (1982). Esta técnica pertenece al grupo de técnicas "outranking", que ofrecen un ranking del conjunto de alternativas basado en relaciones de superación. Una alternativa *a* se dice que guarda una relación outranking con otra alternativa *b* si, teniendo en cuenta toda la información disponible referente al problema y todas las preferencias de los decisores, existe un argumento suficientemente fuerte para apoyar la conclusión de que *a* es al menos tan bueno como *b* y no hay argumentos fuertes para lo contrario (Belton and Stewart., 2001).

PROMETHEE requiere información sobre el peso de los criterios y la función de preferencia. El peso de los criterios muestra la relativa importancia de los criterios considerados. La función de preferencia (P_j) traslada la diferencia entre las evaluaciones obtenidas por dos alternativas para un criterio particular, asignando un grado de preferencia entre 0 y 1.

Si tenemos,

$P_j(a,b)=G_j|f_j(a)-f_j(b)|$, (1)

$0\leq P_j(a,b)\leq 1$, (2)

Siendo la función de preferencia asociada al criterio $f_j(\cdot)$ donde G_j es una función no decreciente de la desviación observada entre $f_j(a)$ y $f_j(b)$.

Para facilitar su identificación se han propuesto seis tipos de función de preferencia (Brans and Mareschal in Figueira et al, 2005) que se muestran en la figura 7.

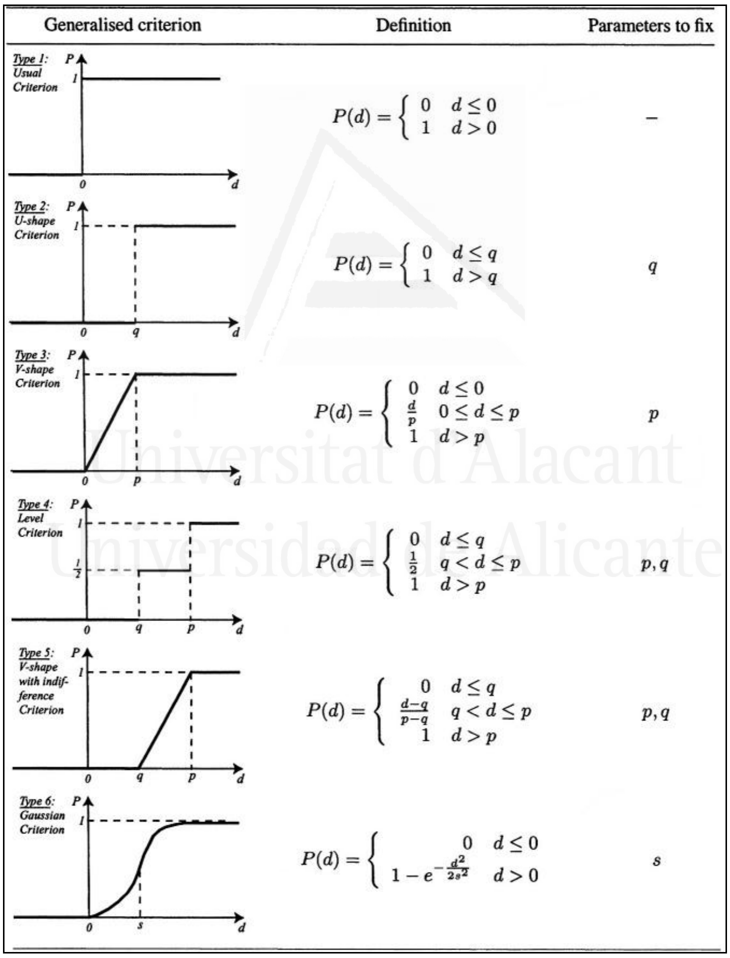


Figura 7. Funciones de Preferencia (Brans and Macharis in Figueiras et al., 2005).

PROMETHEE permite obtener los índices de preferencia agregados (1), los flujos outranking positivos (2), los flujos outranking negativos (3) y los flujos outranking netos(4),

$\Pi_s(a,b)= \sum_{j=1}^{k} P_j(a,b)w_{s,j},$ (1)

$\Phi^+_s(a)=\sum_{x\epsilon A} \Pi_s(x,a),$ (2)

$\Phi^-_s(a)=\sum_{x\epsilon A} \Pi_s(a,x),$ (3)

$\Phi_s(a)= \Phi^+_s(a)- \Phi^-_s(a).$ (4)

Para cada alternativa *a*, perteneciente a un conjunto de alternativas A , $\Pi_s(a,b)$ es un índice de preferencia global de *a* sobre *b*, teniendo en cuenta todos los criterios, $\Phi^+_s(a)$ y $\Phi^-_s(a)$. Esto mide respectivamente la fortaleza y la debilidad de *a* respecto de las otras alternativas. $\Phi_s(a)$ representa una función de valor, donde un mayor valor refleja una mayor preferencia hacia la alternativa *a* . Siendo $\Phi_s(a)$ el flujo neto de la alternativa *a* para el decisor *s* (Macharis et al., 2004).

Existen varias herramientas de la familia PROMETHEE. Las más empleadas son PROMETHEE I y II y GAIA plane (Behzadian et al., 2010). PROMETHEE I obtiene rankings parciales usando flujos positivos y negativos. PROMETHEE II trabaja con los flujos netos para obtener un ranking total de las alternativas. “Geometrical analysis for interactive aid” (GAIA) plane muestra gráficamente la posición relativa de las alternativas en términos de las contribuciones para varios criterios.

Dentro de la familia de PROMETHEE, se han desarrollado otras técnicas que ofrecen diferentes soluciones a los problemas de toma de decisiones como PROMETHEE III, PROMETHEE IV, PROMETHEE V, PROMETHEE VI y PROMETHEE GDSS .

Objeto de la Tesis Doctoral :
"IDENTIFICACIÓN DE ÁREAS DE CONSERVACIÓN Y PROPUESTA DE UN MODELO INTERDISCIPLINAR DE LA PLANIFICACIÓN DE LA CONSERVACIÓN EN ÁREAS PROTEGIDAS".

Esta tesis doctoral se basa en el concepto de áreas protegidas como sistemas ecológicos y sociales donde intervienen agentes ecológicos, económicos, políticos y sociales, que interaccionan entre sí. Considerando las definiciones de ambos conceptos;

Un **Área Protegida (AP)** es un "Espacio geográfico claramente definido, reconocido, dedicado y gestionado, mediante medios legales u otros tipos de medios eficaces para conseguir la conservación a largo plazo de la naturaleza y de sus servicios ecosistémicos y sus valores culturales asociados" (IUCN,2008).
Los **Sistemas Ecológicos y Sociales (SES)** son "Sistemas ecológicos estrechamente relacionado por uno ó más sistemas sociales" (Anderies et al., 2004; Ostrom, 2009).

Los científicos ecologistas y sociales usan diferentes lenguajes, marcos de trabajo, teorías y modelos. Sin embargo, la comprensión de que la sostenibilidad de los sistemas ecosistémicos depende de su relación con los sistemas humanos ha hecho que, en los últimos años, se hayan realizado verdaderos esfuerzos en definir marcos de trabajo que analicen las interacciones entre ambas disciplinas (Costanza et al., 2001).

El conocimiento científico es necesario para fortalecer y mantener los SESs, pero las ciencias sociales y ecológicas se han desarrollado de manera independiente y no resulta sencillo combinarlas (Norgaard, 2008). La investigación en ciencias sociales y en ciencias naturales utilizan en muchas ocasiones las mismas técnicas de optimización, pero emplean diferentes funciones objetivo. Los científicos ecologistas utilizan funciones objetivo relacionadas con especies y sostenibilidad de los sistemas, mientras que los científicos economistas y políticos utilizan funciones que utilizan el concepto "coste-eficiencia" y la forma de combinar unidades gubernamentales para lograr elevados niveles de equidad y eficiencia respectivamente (Gibson et al.,2000). Las áreas protegidas integran agentes con intereses muy distintos, y en muchas ocasiones, contrarios y resulta imprescindible hacer compatibles estas funciones objetivo para maximizar los intereses de los agentes. La interdisciplinariedad adquiere un importante protagonismo en este contexto.

La biología de la conservación proporciona un enfoque teórico que refleja esta interdisciplinariedad aunque priorizando en todo momento el objetivo de la conservación a largo plazo de las comunidades biológicas por encima de consideraciones económicas. La protección de especies raras, el diseño de parques y reservas naturales, la creación de planes de gestión para parques y áreas de usos múltiples deben ser conciliados con los intereses de conservacionistas, las necesidades de las poblaciones locales, las administraciones y gobiernos (Primack and Ros, 2002).

La planificación de la conservación debe diseñarse con el objetivo de alcanzar este difícil reto. Margules and Pressey (2000) identifican seis pasos para sistematizar la planificación de la conservación:

(1) Recopilar datos sobre la biodiversidad en una región
(2) Identificar objetivos de conservación
(3) Revisar áreas de conservación existentes
(4) Seleccionar áreas de conservación adicionales
(5) Implementar acciones de conservación
(6) Mantener los valores requeridos para la conservación de las áreas

Los cuatro primeros pasos se refieren a la identificación de áreas a proteger y los dos restantes se refieren a la conservación de las áreas ya protegidas. Dicho de otra forma, primero hay que proteger y luego hay que proteger de manera eficiente.

El modelo propuesto en esta tesis pretende responder a estos dos grandes retos: dónde proteger y cómo proteger. Para ello se propone un enfoque multidisciplinar que usa conceptos y herramientas de doctrinas del ámbito ecológico pero también socio-político, como la nueva economía institucional y la investigación operativa, que tiene su base en la combinación de modelos económicos, matemáticos y estratégicos.

Dónde Proteger:

La creación de reservas naturales es una componente clave, "costo-eficiente", para la conservación de la diversidad biológica (Balmford et al.,2002). La pérdida acelerada de biodiversidad en las últimas décadas ha originado una preocupación por proteger espacios naturales fundamentalmente desde la década de los noventa (WDPA, 2011).
Un proceso de planificación de la conservación debe incluir la revisión de las reservas existentes y la selección de reservas adicionales (Margules and Pressey, 2000), sin embargo uno de los grandes retos en el diseño de redes de reservas es definir una visión unificada sobre las prioridades de conservación para la selección de áreas protegidas. Esto se ve reflejado en las diferentes conclusiones que muestran algunos trabajos sobre identificación de nuevas áreas protegidas (Hoekstra et al., 2005; Rodrigues et al.,2004a,2004b).

Cómo proteger:

Aunque la cobertura de áreas protegidas ha sido usada como indicador clave de la protección de la biodiversidad (Naughton-Treves et al., 2005), la evidencia empírica muestra que la designación legal no es suficiente garantía para proteger la biodiversidad (Liu et al.,2001; WWF,2007) y parece necesario considerar la evaluación de la gestión además del número y la extensión de áreas protegidas (Stoll-Kleemann, 2010).
El buen gobierno en las áreas protegidas pone el enfásis en la participación de las comunidades locales en las estructuras de poder y por tanto en la toma de decisiones.

Para que la gestión de los espacios protegidos funcione bien, debe fundamentarse en el buen gobierno. Por otro lado, Abrams et al. (2003) identifican la principal función del buen gobierno en áreas protegidas: crear y mantener las condiciones necesarias para una gestión eficiente. Las áreas protegidas son sistemas ecológicos y sociales donde intervienen un gran número de agentes con intereses contrarios y múltiples interacciones (Anderies et al., 2004). Esta complejidad creciente ha impulsado un nuevo paradigma de la gestión en áreas protegidas que se basa en la participación de las comunidades locales. Un nuevo enfoque de la Teoría de los Comunes (Hardin, 1968) muestra a las poblaciones locales como agentes capaces de gestionar de manera sostenible los recursos naturales en determinadas condiciones de calidad institucional (Ostrom, 1999).

Por otro lado, el protagonismo que ha adquirido la participación de los agentes en las tomas de decisiones en áreas protegidas requiere de herramientas adaptadas para la gestión. El análisis multi-criterio en toma de decisiones colaborativa puede aportar una herramienta útil para implementar el buen gobierno. El análisis multi-criterio permite incorporar la participación en la gestión de las áreas protegidas y resulta especialmente útil para alcanzar acuerdos, al facilitar un marco estructurado para la discusión y la negociación en los procesos de toma de decisiones (Ananda et al.2009; Mendoza and Martins, 2006; Weintraub et al., 2007). Una de las aplicaciones para las que puede resultar útil es para homogeneizar datos y generar información comparable para la red mundial de áreas protegidas.

Esta tesis se divide en tres secciones. En la primera se identifican áreas prioritarias de conservación considerando tres grandes estrategias internacionales. En la segunda se definen los principios de buen gobierno desde un enfoque institucional y en la tercera se propone una modelo multi-criterio de ayuda a la toma de decisiones como una herramienta que permite integrar el buen gobierno en la gestión de áreas protegidas.

El objetivo general de la tesis es identificar áreas prioritarias de protección y proponer un modelo de planificación de la conservación válido para la red mundial de áreas protegidas que permite definir el buen gobierno en áreas protegidas y proponer herramientas para implementarla a través de la gestión.

Los objetivos específicos son:

- Identificar áreas prioritarias de protección considerando objetivos políticos y científicos de conservación.
- Definir los principios de buen gobierno en áreas protegidas desde un enfoque institucional.

- Realizar una revisión exhaustiva del empleo del análisis multi-criterio en la toma de decisiones en áreas protegidas y mostrar su utilidad para incluir la participación de los agentes sociales.
- Proponer un modelo multi-criterio de ayuda a la toma de decisiones que incluye la participación de los agentes de un espacio natural para identificar categorías internacionales de protección en base a las prioridades de los objetivos de gestión.

SECCIÓN I-IDENTIFICACIÓN DE ÁREAS PRIORITARIAS DE CONSERVACIÓN. Capítulo 1

Sabinar relicto (Marruecos). Foto: V. Urios.

LINKING POLITICAL AND SCIENTIFICALLY DERIVED TARGETS FOR GLOBAL BIODIVERSITY CONSERVATION: IMPLICATIONS FOR THE EXPANSION OF THE GLOBAL NETWORK OF PROTECTED AREAS.

Álvaro Soutullo,*Mónica de Castro and Vicente Urios

CIBIO- Estación Biológica Terra Natura, Universidad de Alicante, Campus San Vicente del Raspeig s/n, Edificio Ciencias III, 03080 Alicante, Spain

ABSTRACT

Despite the global network of protected areas covers 12% of the world's land surface, its performance is still unsatisfactory. Although political and scientifically sound conservation targets usually portray different pictures of the task ahead, we show that in terms of priority areas for expanding the global network of reserves, there is much agreement between the political targets of the Convention on Biological Diversity (CBD), and the scientifically derived goals endorsed by international conservation organizations. Here we analyse four global databases to identify priority areas for fulfilling the CBD target of representing 10% of every ecological region within protected areas, and compare the distribution of priority regions for fulfilling that political target, with the distribution of the priority areas for global biodiversity conservation identified by Conservation International, the WWF, and the Wildlife Conservation Society on scientific basis. For 63% (549) of the world's terrestrial ecoregions the CBD 10% target is still not met; fulfilling it requires protecting another 4.6% of the Earth's land surface (6,239,894 km2). Yet, at least 78% of the priority regions for fulfilling that target lay within priority regions for the main global conservation strategies. By pursuing the political target set by the CBD much ancillary gains in terms of other global conservation objectives can be obtained.

Keywords:

Biodiversity Hotspots, conservation planning, ecoregions, gap analysis, Global 200, Last of the Wild, reserves.

INTRODUCTION

The conservation of biological diversity is one of mankind's greatest challenges to ensure its long-lasting well-being (Costanza et al., 1997; Balmford et al., 2002). The creation of nature reserves is a key, cost-efficient, component of that enterprise (Balmford et al., 2002). Actually, setting aside areas for the preservation of natural values is an ancient and widespread human practice (Margules and Pressey, 2000). For almost two decades one of the main global conservation goals has been the consolidation of an international network of protected areas covering 10% of the world's surface (IUCN, 1993). The network currently covers 12% of the planet's land surface (Chape et al., 2005), but its performance is still far from convincing (Brooks et al., 2004; Rodrigues et al., 2004a,b; Hoekstra et al., 2005). One of the reasons for this limited success is the lack of a strong scientific foundation for such fixed percentage targets: despite they are politically appealing, land surface is not a good proxy for biodiversity (Soulé and Sanjayan, 1998; Rodrigues et al., 2004b; Tear et al., 2005). As a matter of fact, most global biodiversity conservation strategies recognize the need to protect a much larger percentage (19.8% ± 11.9) of the Earth's land surface (Brooks et al., 2006). Clearly,global biodiversity conservation requires expanding the network of protected areas (Brooks et al., 2004).

Despite the shortcomings of fixed targets, the agreement of the 190 countries signatories of the Convention on Biological Diversity (CBD) of working together to ensure that 10% of all ecological regions is effectively conserved (e.g. Chape et al., 2005; CoP 7 Decision VII/30: Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes – Target 1.1: At least 10% of each of the world's ecological regions effectively conserved) is arguably one of the most significant global conservation achievements (Balmford et al., 2005). Mostly because it means that nations (not only conservation-concerned organizations and individuals) have assumed the legal and political responsibility of implementing measures to ensure that this target is met. Hence, despite its limitations, it seems obvious that a basic criterion to consider when planning the expansion of the global network of protected areas is to ensure that 10% of all of the planet's ecoregions are represented within reserves. Among other things because nations have already assumed that responsibility, and thus, are bound to enforce the implementation of actions aimed at meeting that target. This is even more relevant in the absence of a consensus scientifically sound strategy to expand the network.

Unfortunately, this is the case. Extant proposals for expanding the global network of protected areas portray very different conclusions regarding where new reserves are most needed (e.g.Rodrigues et al., 2004a; Hoekstra et al., 2005). This is in part because scientists and conservation organizations do not have a unified view of which regions are most relevant for global biodiversity conservation. This in turn is a consequence of both the different ways in which the biodiversity value of a site can be assessed (e.g. Noss, 1990; Maddock and Du Plessis, 1999; Cowling et al., 2004), and the different criteria that might be used to identify priorities for action (e.g. Orme et al., 2005; Brooks et al., 2006; Ceballos and Ehrlich, 2006). Thus, extant templates do not provide a clear guide to inform the expansion of the global network of protected areas. Together, they identify 79% of the Earth's land surface as a conservation priority (Brooks et al., 2006). Thus, the question of where new protected areas have to be created does not have a simple, unique answer. Clearly, regions that most of these templates identify as priority are good candidates. Yet, in the face of the CBD target, another (compatible) alternative is to expand the network in those ecoregions where that target has not been met yet, trying in the process to maximize the ancillary gains in terms of the other conservation targets ascribed by the extant global conservation strategies. Here we identify priority regions for the expansion of the global network of terrestrial protected areas in order to fulfil the CBD 10% target at a minimum cost in terms of land surface protected, and evaluate the contribution of these regions to augment ancillary gains in terms of other global conservation objectives. To do that we compared the distribution of the global network of protected areas with the distribution of three of the nine major global biodiversity conservation templates. These three templates are representative of the three general approaches used for conservation prioritization (Brooks et al., 2006), prioritizing (1) highly vulnerable regions (Biodiversity Hotspots), (2) irreplaceable regions (Global 200 ecoregions and Biodiversity Hotspots), and (3) regions of low vulnerability (Last of the Wild places). As there is significant overlap in the priority regions identified by templates using the same approach, but not in those identified by templates using different approaches, the three templates we used incorporate most of the priority regions identified by all the nine templates (Brooks et al., 2006).

Our aim with this analysis was threefold. First, within the terrestrial domain identify how much more protected area is required to meet the CBD target of protecting at least 10% of all terrestrial ecoregions. Second, identify at a global scale regions where new protected areas are to be created to accomplish that target. Third, evaluate to what degree expanding the global network of protected areas in those regions would contribute to gain ancillary benefits in terms of other global conservation objectives.

METHODS

To identify priority regions for the expansion of the global network of reserves within the terrestrial domain, we used data on the global distribution of protected areas obtained from the 2005 World Database on Protected Areas (WDPA, 2005). For protected areas we only considered areas protected at the national level that have been assigned an IUCN category, as it is arguable whether other areas included in the database actually contribute to biodiversity protection in their current situation: many are not true nature reserves (e.g. urban parks, military and indigenous reservations, and forest plantations). Using the IUCN categories clarifies the aims of the areas identified as protected areas, provides international standards for accounting and comparisons, a framework for collection, handling and dissemination of protected areas data, and is the standard approach used for analysing the coverage of the global network of protected areas for planning purposes (e.g. Rodrigues et al., 2004a; Hoekstra et al., 2005). Although considering only reserves that abide to the IUCN criteria leaves outside of the analyses 38,404 protected areas listed in the WDPA (2005) (which cover a total surface of 4,586,652 km2), only 27,951 of these are actually designated and can be located on a map, covering 2,943,772 km2 (WDPA, 2005). Moreover, 60% of this surface lay in Brazil, the Russian Federation, Colombia, Peru, and Venezuela, countries with strong IUCN presence, suggesting that there are good reasons not to consider these areas as nature reserves in the IUCN sense.

Although the WDPA provides both point and polygon data, for the analyses we initially considered point data, as polygon data were only available for some reserves (see e.g. Rodrigues et al., 2004a,b; Chape et al., 2005). Contrary to Hoekstra et al. (2005), protected areas identified as marine at the WDPA were not a priori excluded because many of them encompass large areas of terrestrial ecoregions like islands and coastal zones. As the CBD does not specify which classification of the world's ecological regions is the most appropriate to assess the progress towards the 10% target, for this analysis we decided to use the WWF classification of the world's terrestrial ecoregions (Olson et al., 2001), which is largely used by many national and international conservation organizations. Data on terrestrial ecoregions were thus obtained from the WWF (2005). To be consistent with Global 200 (G200) ecoregions (Olson and Dinerstein, 1998) and Biodiversity Hotspots (BH) (Mittermeier et al., 2004) classifications, we used the original ecoregions proposed by the WWF (Olson et al., 2001), not the recently revised version 2, which recognizes 825, not 867 terrestrial ecoregions. To calculate ecoregions' surface we transformed the original database in degrees to an equal-area cylindrical projection.

Protected areas were assigned to the ecoregions where the points representing them were located. As many protected areas encompass more than one ecoregion, we revised the initial assignation by calculating for each protected area a circular buffer of the size of the area's surface (except for those areas for which boundaries were available as polygon shapefiles in the WDPA, as in these cases we used the original information), and assigned the areas to the ecoregion including the largest proportion of the polygon. For each ecoregion we calculated the number of percentage of the ecoregion within protected areas. These metrics were calculated for both all reserves in IUCN categories, and only those in categories I–IV. We proceeded in this way because the primary objective of reserves in categories I–IV is nature conservation, whereas for reserves in categories V and VI the main objective is sustainable use. Hence, it is arguable which group of reserves provides the best picture of the actual contribution of reserves networks to biodiversity conservation (Brooks et al., 2004; Rodrigues et al., 2004a,b; Hoekstra et al.,2005; Soutullo and Gudynas, 2006).

We then compared the distribution of the ecoregions with less than 10% of their surface protected (considering IUCN categories I–VI), with the distribution of the priority regions of the three global biodiversity conservation templates analysed. Data on BH were obtained from Conservation International (2005), data on the 'Last of the Wild' (LTW) places (Sanderson et al., 2002) from the Wildlife Conservation Society and Columbia University's CIESIN (2006), and data on G200 ecoregions from the WWF (2005). To calculate the total land surface covered by the three global conservation templates we merged the shapefiles into a single map and projected it into an equal-area cylindrical projection. Finally, to identify which of the underrepresented ecoregions (i.e. those with < 10% of their surface within protected areas) were also considered priority regions by each template, we generated a map of underrepresented ecoregions and used it to clip each template map. All analyses were conducted in Arcview 3.2.

With the data provided in the WDPA, 13,033 reserves (covering 2,080,232 km2) were not initially assigned to any of the terrestrial ecoregions. After our correction only 9010 remained unassigned (covering 325,936 km2). The surface assigned includes 1,686,494 km2 of 1683 reserves indicated as marine in the WDPA that only marginally encompass terrestrial ecoregions, if any. These were not considered in further analyses. The remaining 1969 reserves that are indicated as marine in the WDPA (2005) encompass large portions of terrestrial ecoregions and hence, were assigned to one of them. Of the remaining 371, only 45 could not be assigned to any terrestrial ecoregion despite having information on their location.For the rest no geographical coordinates are provided in the WDPA (2005).

There are, however, some caveats on the accuracy of the figures that can be obtained from analyses of the coverage of the global network of protected areas, as data in the WDPA have certain degree of inaccuracy and incompleteness, and there are limitations on the accuracy with which reserves can be assigned to ecoregions (Rodrigues et al., 2004a; Chape et al., 2005). Particularly relevant for this analysis are inaccuracies on reserves' size and boundaries, as they preclude exact evaluations of the extent of ecoregional representation of the global network of protected areas. Furthermore, in many countries there is overlap between protected areas (e.g. Soutullo and Gudynas, 2006), and thus, a simple summation of their surfaces would produce an inflated estimate of total coverage (Chape et al., 2005). Our estimates are, however, more conservative than those of Chape et al. (2005). This is because in their analysis they include protected areas that are currently not designated, cannot be located in a map (as there is no location information available), or are simply not nature reserves (as urban parks and military and indigenous reservations). In contrast, our estimates are likely to be inflated by double-counting overlapping reserves, suggesting that had double-counting been avoided the estimate of the total coverage of the global network of protected areas would have been even smaller. Given the inaccuracy and incompleteness of the WDPA, it is impossible to calculate an accurate value of the current coverage of the network, but we believe that our estimates are a convenient compromise between those two extremes and provide a less biased estimate of the world land surface that is currently protected in actual nature reserves than Chape et al.'s (2005).

Figures on individual ecoregions are probably more inaccurate and should be used with caution, especially in those regions of the world for which available data are less reliable, there is known overlap between designated reserves, and the reserves span over several ecoregions. This can result in errors of both 'commission' and 'omission' when assigning the reserves to the ecoregions (Chape et al., 2005). For example,despite being considered for many as a protected area in its entirety, the level of protection attributed by the WDPA to Antarctica is much lower (Chape et al., 2005). Still, these figures are the best currently achievable estimates, and their reliability is comparable to that provided by other similar analyses (e.g. Rodrigues et al., 2004a,b; Chape et al., 2005; Hoekstra et al., 2005). More detailed assessments of the ecoregional coverage of regional networks of protected areas are available for some of the main world's regions (e.g. Dinerstein et al., 1995; Ricketts et al., 1999; Wikramanayake et al., 2002; Burgess et al., 2004; Soutullo and Gudynas, 2006).

RESULTS

Coverage of the world's terrestrial network of protected areas and gaps with respect to the CBD 10% target

We analysed the protection provided by 70,382 areas identified as conservation reserves in the WDPA (2005) to 867 terrestrial ecoregions. The added surface of these reserves covers 16,294,039 km2, which represents 11% of the world's land surface.

Yet, many of them are marine reser ves that do not include terrestrial ecoregions, and for other there is no information on their location. Only 14,281,394 km2 of the Earth are protected within terrestrial reserves that can be located on a map (although many overlap). When only reserves in IUCN categories I–IV are considered, this value drops to 8,323,666 km2 . These figures represent 9.7% and 5.7% of the Earth's land surface, respectively.

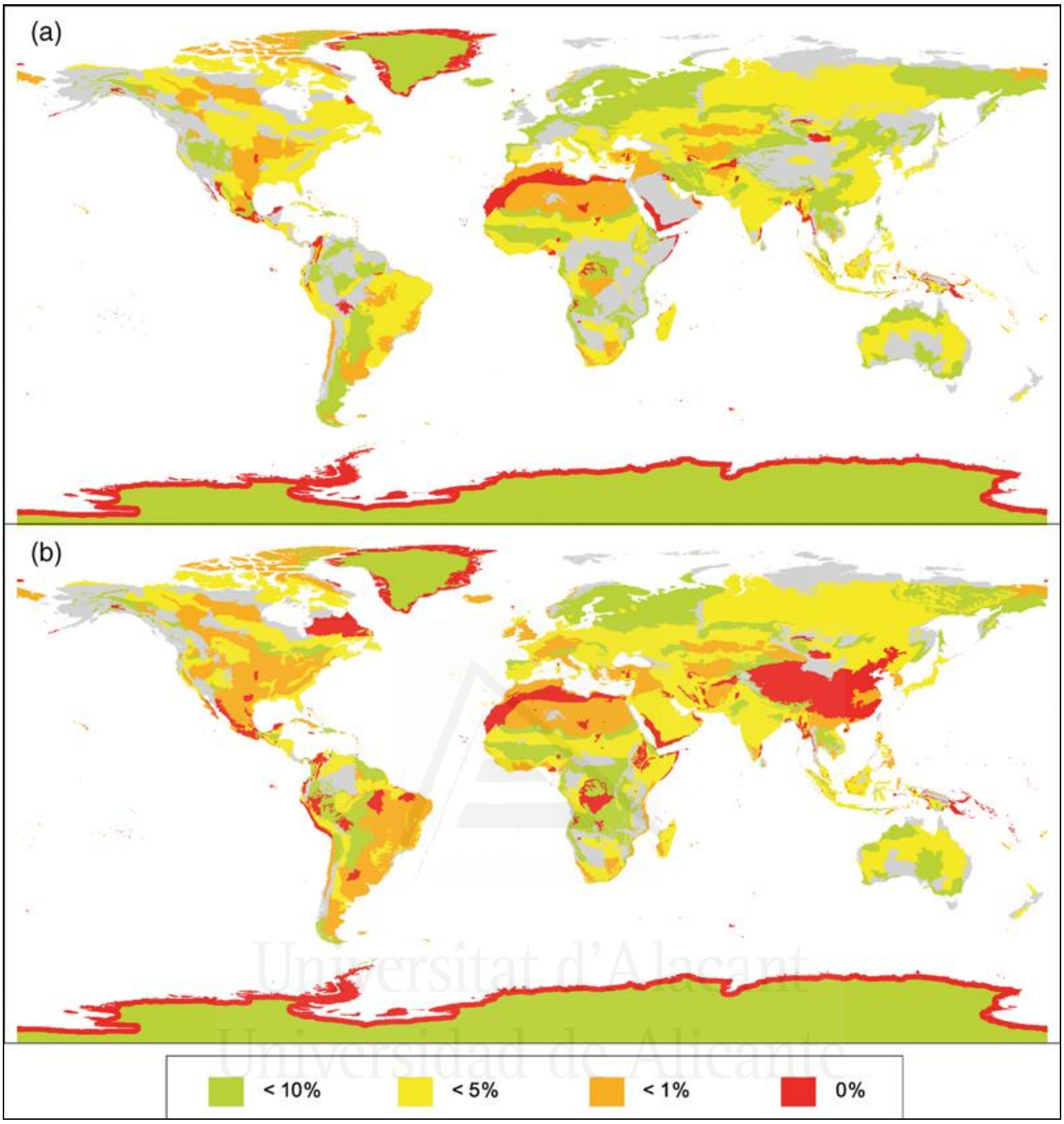


Figure 1 Ecoregional coverage of the global network of protected areas. (a) Coverage provided by reserves in IUCN categories I–VI. (b) Coverage provided by reserves in IUCN categories I–IV.

Yet, 63% (549) of the Earth's terrestrial ecoregions have less (6.3% if the target is to be achieved within reserves in categories than 10% of their surface within protected areas, 77% if only I–IV reserves in IUCN categories I–IV are considered (Fig. 1). For the global network of protected areas to ensure that 10% of every ecoregion is protected within reserves, another 6,239,984 km^2 would have to be protected (8,539,564 km^2 if the aim is to achieve that 10% within reserves in categories I–IV). That is, for the global network of protected areas to fulfil the CBD 10% target, it has to cover at least another

4.6% of the Earth's land surface(6.3% if the target is to be achieved within reserves in categoriesI–IV; Table 1).

Priority regions for the expansion of the global network of protected areas

Together the three global conservation templates we analysed include 88% of the priority areas identified by the nine major global biodiversity conservation templates (Brooks*et al*., 2006), and cover 70% of the Ear th's land surface. Expanding the network of terrestrial reserves in ecoregions where the 10% target has not been met yet can provide much ancillary gains in terms of these global strategies' conservation objectives.

Region	No. of ecoregions	No. of underrepresented ecoregions	% underrepresented ecoregions	Region surface (km^2)	Additional surface to CBD 10% target (km^2)	% of region to CBD 10% target
Australasian	83	46	55%	9,247,689	362,516	4%
Afrotropical	114	77	68%	21,642,644	738,529	3%
Indo-Malayan	106	71	67%	8,524,365	443,411	5%
Neartic	119	70	59%	20,421,474	1,014,164	5%
Neotropical	219	135	62%	19,338,623	857,620	4%
Oceanic	24	17	71%	47,054	2,816	6%
Palearctic	196	127	65%	52,680,534	2,409,077	5%

Table 1. Coverage of the world's network of terrestrial protected areas for each of the main biogeographic regions. For each region the number and percentage of ecoregions for which the Convention on Biological Diversity (CBD) 10% target is still not met, and the additional land surface to be protected to meet that target, are shown.

The 549 underrepresented ecoregions (Fig. 2a) include 427 ecoregions (i.e. 78%) that are considered a priority by at least one of the global conservation strategies analysed: 254 of the 400 BH ecoregions, 200 of the 348 G200 ecoregions, and 198 of the 357 ecoregions that include LTW places. Although the remaining 122 underrepresented ecoregions are not priority for any of these templates, several are considered priority regions by some of the other six global conservation strategies. Clearly, taking into account global conservation agreements, future attempts to improve the coverage of the global network of terrestrial reserves should regard the 549 underrepresented ecoregions as priority regions for its expansion.

Most interestingly, 62 of the world's terrestrial ecoregions are considered priority regions by the three strategies analysed (Fig. 2b, Table 2). These are areas of high conservation value irrespective of how biodiversity is measured, highlighting the need to ensure their protection. However, 33 of these are still underrepresented in the global network of protected areas (Table 2). Fulfilling the CBD target for these regions only requires protecting another 2088 km2. Yet, being regions of remarkable conservation value, conservation targets there should probably be much more ambitious.

DISCUSSION

Despite the bewildering diversity of criteria and metrics used to set global conservation priorities, and the discouraging disparity in the priority regions for global conservation action identified by the main conservation organizations (Brooks et al., 2006), a substantial improvement in global biodiversity conservation might be achieved by simply enforcing extant conservation agreements. Moreover, we have shown that in terms of the expansion of the global network of protected areas, the most cost-effective global conservation tool (Balmford et al., 2002), there is much more common ground between political and scientific targets than usually acknowledged (e.g. Rodrigues et al., 2004b). Fulfilling the CBD target of representing 10% of every ecoregion within reserves implies that the network should cover at least another 4.6% of the Earth's land surface. Yet, at least 78% of the ecoregions we identified as priority for the expansion of the network are also priority regions for the main global biodiversity conservation strategies.

One of the explicit purposes of international NGO's global conservation templates is to guide international conservation spending (Olson and Dinerstein, 1998; Myers et al., 2000; Brooks et al., 2006; Halpern et al., 2006). Thus, one of the potential contributions of this analysis is to aid donors in targeting regions where financial support is most needed to meet the CBD 10% target. In most cases, these regions have been already identified as priority for action by the main international conservation organizations. Thus, by directing a larger share of their conservation efforts towards underrepresented regions, these conservation NGOs can make a significant contribution to the fulfilment of the CBD target while still fulfilling their own targets. This does not require changes in their objectives, but only changes in the priority or relative importance they give to their different targets. In contrast, to meet the CBD target in underrepresented ecoregions that are not a priority for any global biodiversity conservation strategy, specific strategies need to be implemented. Especially taken into account that the amount of money annually spent in regions that have not been recognized as priority for action by international conservation organizations is two to 16 time fewer than that spent in regions identified as priority (Halpern et al., 2006). The CBD secretariat should play an active role in persuading donors of directing conservation efforts towards these regions.

In any case, biodiversity value and unmet conservation targets are not the only considerations to take into account when prioritizing conservation effort. Given the gross mismatch between the costs of effective biodiversity conservation and current spending, there is also a need to take into account economic considerations when planning for action (Balmford et al., 2000, 2003; Halpern et al., 2006). This is because if the relative cost of investing in different regions is not taken into account, then there is the risk of spending resources in regions where only comparatively modest gains can be obtained.

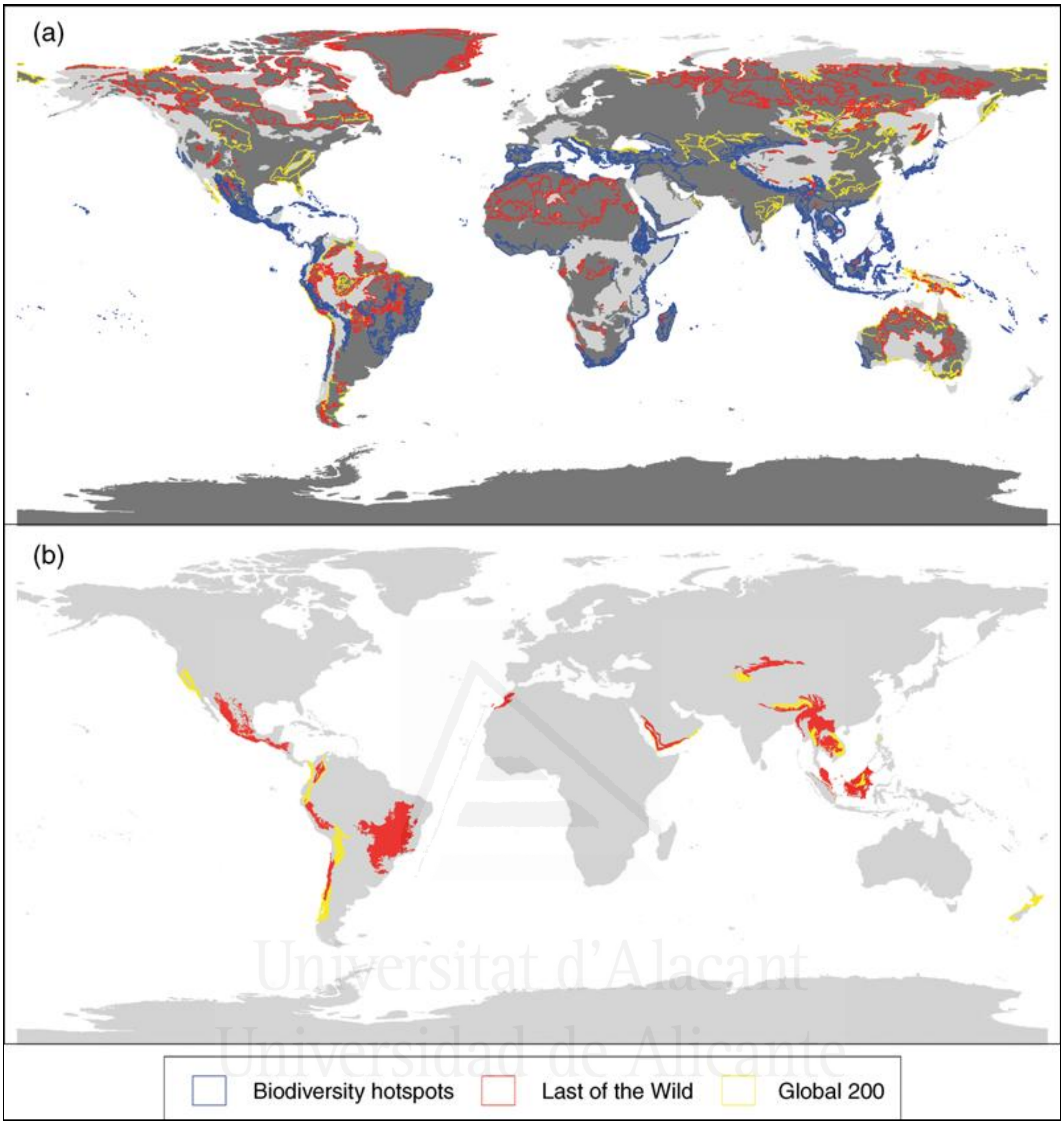


Figure 2 (a) Priority regions for the expansion of the global network of protected areas (in dark grey) within Biodiversity Hotspot, Global 200 ecoregions (G200), and Last of the Wild (LTW) places. (b) Ecoregions identified as conservation priority by the BH, G200, and LTW templates (in yellow). Those for which the CBD 10% target is still not met are highlighted in red.

Allocation decisions should aim at maximizing gains given a constrained budget (Wilson*et al*., 2006). This is particularly relevant with respect to the $US 0.5–1.5 billon that are annually allocated by globally flexible funding bodies as multilateral agencies, bilateral aid, and private sources (James *et al*., 1999;Halpern *et al*., 2006). As annual cost of effective field-based conservation varies enormously across the globe (from

\$US< 0.1 to > 1,000,000 per km^2), the gains obtained by investing in different regions may also vary enormously (Balmford et al., 2003). Ranking regions based on individual criteria (as is currently relevant with respect to the \$US 0.5 –1.5 billon that are annually done at the global scale) does not provide an obvious schedule allocated by globally flexible funding bodies as multilateral for resource allocation or a rationality for resource partitioning agencies, bilateral aid, and private sources (James et al., 1999; (Wilson et al., 2006). Fortunately, general frameworks to plan general frameworks to plan optimal annual funding allocation given current state of the system and possible events in the future are already available (Wilson *et al*., 2006). This opens the possibility of putting forward a coherent strategy towards fulfilling the CBD 10% target, which requires that CBD members persuade donors of the need of working together, and a coordinated allocation of funding.Actually, fulfilling the CBD target for the 33 underrepresented ecoregions identified as conservation priorities by the three strategies analysed only requires protecting another 2088 km^2 of land surface, suggesting it might be relatively inexpensive to meet it. Yet, being highly regarded by the three templates it seems reasonable to assume that for these and the other consensus ecoregions, conservation targets should probably be much more ambitious.

Ecoregion	Ecoregion code	Surface of ecoregion (km^2)	No. of PAs	% protected	Size of PAs (mean ± SD)
AUSTRALASIAN REGION					
Fiordland temperate forests	AA0403	11,027	3	100	4192 ± 7255
Nelson Coast temperate forests	AA0404	14,575	322	90.1	41 ± 285
North Island temperate forests	AA0405	84,424	1107	18.9	14 ± 103
Richmond temperate forests	AA0408	13,197	215	37.4	23 ± 141
South Island temperate forests	AA0410	11,684	178	12.2	8 ± 43
Westland temperate forests	AA0414	5,276	151	80.3	28 ± 176
AFROTROPICAL REGION					
Arabian Peninsula coastal fog desert	AT1302	82,969	4	11.7	2424 ± 2414
Southwestern Arabian foothills savanna	**AT1320**	**274,663**	**4**	**0**	**2 ± 4**
Indo-Malayan region					
Borneo lowland rain forests	**IM0102**	**427,511**	**77**	**2.8**	**157 ± 383**
Borneo montane rain forests	IM0103	115,600	11	32.4	3401 ± 5269
Kayah-Karen montane rain forests	IM0119	119,541	25	19.4	926 ± 893
Mizoram-Manipur-Kachin rain forests	**IM0131**	**135,558**	**11**	**1.4**	**178 ± 159**
Northern Annamites rain forests	IM0136	47,207	11	22.6	969 ± 1018
Northern Indochina subtropical forests	**IM0137**	**437,007**	**79**	**5.1**	**283 ± 520**
Northern Triangle subtropical forests	**IM0140**	**53,874**	**1**	**7.5**	**4052 ± 0**
Peninsular Malaysian montane rain forests	**IM0144**	**17,174**	**7**	**4**	**99 ± 243**
Peninsular Malaysian rain forests	**IM0146**	**125,505**	**72**	**5.2**	**90 ± 515**
Southern Annamites montane rain forests	IM0152	46,487	14	11.3	376 ± 571
Central Indochina dry forests	**IM0202**	**320,078**	**30**	**7.8**	**828 ± 1198**
Southeastern Indochina dry evergreen forests	IM0210	124,260	36	18.7	646 ± 848
Luzon tropical pine forests	IM0302	7,076	7	20.2	204 ± 285
Northeast India-Myanmar pine forests	**IM0303**	**9,705**	**1**	**0.1**	**6 ± 0**
Eastern Himalayan broadleaf forests	**IM0401**	**83,050**	**17**	**9.6**	**469 ± 550**
Northern Triangle temperate forests	**IM0402**	**10,727**	**0**	**0**	**0 ± 0**
Eastern Himalayan subalpine conifer forests	IM0501	27,479	8	19.5	671 ± 623
Terai-Duar savanna and grasslands	**IM0701**	**34,581**	**8**	**6.2**	**269 ± 166**
Kinabalu montane alpine meadows	IM1001	4,339	3	49.7	719 ± 698
Sunda Shelf mangroves	**IM1405**	**37,448**	**14**	**3**	**80 ± 178**
NEARTIC REGION					
Sierra Madre Occidental pine–oak forests	**NA0302**	**222,739**	**22**	**6.9**	**699 ± 1665**
Sierra Madre Oriental pine–oak forests	**NA0303**	**65,633**	**7**	**6.7**	**624 ± 899**
Sierra Nevada forests	NA0527	52,832	46	90.2	1036 ± 1480
California coastal sage and chaparral	NA1201	36,268	31	10.2	119 ± 331
California interior chaparral and woodlands	NA1202	64,599	39	14.3	237 ± 1131
California montane chaparral and woodlands	NA1203	20,408	19	37.3	401 ± 826
NEOTROPICAL REGION					
Bolivian Yungas	NT0105	90,550	6	38.6	5823 ± 6927
Chocó-Darién moist forests	NT0115	73,628	8	11.3	1036 ± 1938
Cordillera Oriental montane forests	NT0118	67,873	30	27.8	629 ± 1172
Eastern Cordillera real montane forests	NT0121	102,497	13	19.7	1553 ± 1674
Magdalena Valley montane forests	**NT0136**	**105,061**	**13**	**2**	**164 ± 427**
Alta Paraná Atlantic forests	**NT0150**	**483,831**	**92**	**3.2**	**167 ± 400**
Peruvian Yungas	**NT0153**	**186,717**	**9**	**3.9**	**809 ± 950**
Atlantic dry forests	**NT0202**	**115,108**	**1**	**4.6**	**5261 ± 0**
Jalisco dry forests	**NT0217**	**26,129**	**19**	**0.9**	**12 ± 32**
Marañon dry forests	**NT0223**	**11,372**	**0**	**0**	**0 ± 0**
Sinaloan dry forests	**NT0228**	**77,535**	**4**	**1.9**	**360 ± 449**
Southern Pacific dry forests	**NT0230**	**42,427**	**6**	**0.7**	**51 ± 63**
Central American pine–oak forests	**NT0303**	**111,350**	**59**	**4.6**	**87 ± 249**
Sierra Madre del Sur pine–oak forests	**NT0309**	**61,177**	**0**	**0**	**0 ± 0**

Table 2 Ecoregions identified as conservation priority by the Biodiversity Hotspots, Global 200 ecoregions, and Last of the Wild templates. The 33 ecoregions for which the Convention on Biological Diversity 10% is still not met are indicated in bold.

In any case, being regions identified as priority by three global conservation strategies, it is also likely that they are already receiving a disproportionate share of the global spending in conservation (Halpern et al., 2006). There is growing evidence that the total area that can be effectively conserved for a fixed annual spend increases with its wilderness and decreases with population density and GNP (e.g.Balmford *et al*., 2003). This highlights the need to derive more funding into conservation in developing countries in Asia, Africa, Northern Eurasia, Middle East, and Latin America, where not only current conservation spend is lower, but also unmet conservation needs are greatest (James *et al*., 1999, 2001;Balmford *et al* ., 2003). According to Wilson *et al*. (2006), in a scenario with uncertainty regarding the ability to invest in a region for the whole period needed to meet established targets, maximizing short-term gains is likely to provide the greatest rewards. Thus, for expanding the world's network of protected areas, increasing the spending in underrepresented ecoregions in developing countries in Asia, Africa, Northern Eurasia,Middle East, and Latin America might be a good investment, as
it would maximize the total land surface actually protected. Yet, with 90% of the global spending on protected areas currently spent in developed countries (James
et al., 1999, 2001), it seems that for the CBD 10% target to be met there is a need for substantial north–south transfer of resources (e.g. Balmford *et al*., 2003).

Actually, this tendency of people to care most about what is close to them (Hunter & Hutchinson, 1994) is probably one of the reasons why reserve networks in developing regions, where local funding for conservation action is more limited, are often underdeveloped. Of course, across the globe land value and conflicts with other activities and land uses have played a chief role in limiting the establishment of representative networks of protected areas (Pressey, 1994; Margules and Pressey, 2000), with human density and GNP being fair estimators of land value and conflicts (Balmford *et al*., 2003; Luck *et al*., 2004).

In any case, ecoregions are very large regions that contain land with a wide range of conservation value. Without careful planning the CBD target can be met by incorporating to the network of reserves areas of scarce conservation value. For conservation action to be effective there is a need to translate prioritization exercises at the global scale into actual conservation implementation at the local level. The WWF has developed a set of guidelines to proceed from the ecoregional to the local level (e.g.

Loucks *et al*., 2004), but the most remarkable example of the application of the general approach of systematic conservation planning (Margules and Pressey, 2000) for the implementation of a conservation strategy within a priority region is the experience currently underway in the Cape Floristic Region (Balmford, 2003; Cowling & Pressey, 2003; Cowling *et al*., 2003). A reasonable strategy to achieve the CBD 10% target might thus involve a first stage in which the annual funding aimed at expanding the global network of reserves in different regions of the world is allocated using the approach put forward by Wilson *et al*. (2006), and a second stage, at the regional level, in which sites to be incorporated in each regional network are selected following a systematic conservation planning approach as shown by Cowling and Pressey (2003) and Cowling *et al*. (2003). To do this, global-scale analyses as the one we present here should be fine-tuned to incorporate more detailed locally available data. Conservation planning at that level plays the key role in maximizing the ancillary gains of expanding the global network of protected areas in those ecoregions where the CBD 10% target has not been met yet.

Thus, a sensible approach to plan the expansion of the global network of protected areas would involve identifying candidate sites within the 549 ecoregions for which the CBD 10% target is still not met, that may maximize ancillary gains in terms of other global conservation objectives. As many ecoregions will be shared by two or more countries, it is essential that at the regional level countries' actions are properly coordinated (Soutullo and Gudynas, 2006). The CBD secretariat should play a chief role in coordinating the actions needed to implement such a strategy, and in fostering agreements to ensure that the global spending for conservation is wisely allocated.

REFERENCES

Balmford, A.2003. Conservation planning in the real world:South Africa shows the way. Trends in Ecology & Evolution, 18:436–438.

Balmford, A., Gaston, K.J., Rodrigues, A.S.L. and James, A.2000. Integrating costs of conservation into international priority setting. Conservation Biology, 14: 597–605.

Balmford. A., Bruner, A., Cooper, P., Costanza, R., Farber, S.,Green, R.E., Jenkins, M., Jefferiss, P., Jessamy, V., Madden, J.,Munro, K., Myers, N., Naeem, S., Paavola, J., Rayment, M.,Rosendo, S., Roughgarden, J., Trumper, K. and Turner, R.K.2002. Economic reasons for conserving wild nature. Science,297: 950–953.

Balmford, A., Gaston, K.J., Blyth, S., James, A. and Kapos, V.2003. Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. Proceedings of the National Academy of Sciences USA, 100: 1046–1050.

Balmford, A., Bennun, L., ten Brink, B., Cooper, D., Cote, I.M.,Crane, P., Dobson, A., Dudley, N., Dutton, I., Green, R.E.,Gregory, R.D., Harrison, J., Kennedy, E.T., Kremen, C.,Leader-Williams, N., Lovejoy, T.E., Mace, G., May, R.,Mayaux, P., Morling, P.,Phillips, J., Redford, K., Ricketts, T.H.,Rodriguez, J.P., Sanjayan, M., Schei, P.J., van Jaarsveld, A.S. andWalther, B.A. (2005) The convention on biological diversity's 2010 target. Science, 307: 212–213.

Brooks, T.M., Bakarr, M.I., Boucher, T., da Fonseca, G.A.B.,Hilton-Taylor, C.,Hoekstra, J.M., Moritz, T., Olivieri, S.,Parrish, J., Pressey, R.L., Rodrigues, A.S.L., Sechrest, W.,Stattersfield, A., Strahm, W. and Stuart, S.N.,2004. Coverage

provided by the global protected-area system: is it enough? Bioscience, 54:1081–1091.

Brooks, T.M., Mittermeier, R.A., da Fonseca, G.A.B., Gerlach, J.,Hoffmann, M.,Lamoreux, J.F., Mittermeier, C.G., Pilgrim, J.D.and Rodrigues, A.S.L. 2006. Global biodiversity conservation priorities. Science, 313:58–61.

Burgess, N., D'Amico Hales, J., Underwood, E., Dinerstein, E.,Olson, D., Itoua, I., Schipper, J., Ricketts, T. and Newman, K.,2004. Terrestrial ecoregions of Africa and Madagascar: acontinental assessment. Island Press, Washington D.C.

Ceballos, G. and Ehrlich, P.R.,2006.Global mammal distributions,biodiversity hotspots, and conservation. Proceedings of the National Academy of Sciences USA, 103:19374–19379.

Chape, S., Harrison, J., Spalding, M. and Lysenko, I.,2005.Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. Philosophical Transactions of the Royal Society of London Series B, Biological

Sciences, 360: 443–455.

Center for International Earth Science Information Network (CIESIN) 2006.Last of the wild project (http://www.ciesin. columbia.edu/wild_areas/, Accessed on 10 August 2006).

Conservation International,2005. Biodiversity hotspots.
(http://www.biodiversityhotspots.org/xp/Hotspots, Accessed on 18 October 2005).

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M.,Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J.,Raskin, R.G., Sutton, P. and van den Belt, M.,1997. The value of the world's ecosystem services and capital value. Nature, 387:

253–260.

Cowling, R.M., Knight, A.T., Faith, D.P., Ferrier, S., Lombard,A.T., Driver, A., Rouget, M., Maze, K. and Desmet, P.G.,2004.Nature conservation requires more than a passion for species.Conservation Biology, 18: 1674–1676.

Cowling, R.M. and Pressey, R.L.,2003.Introduction to systematic conservation planning in the Cape Floristic Region. Biological Conservation, 112: 1–13.

Cowling, R.M., Pressey, R.L., Rouget, M. and Lombard, A.T.,2003.A conservation plan for a global biodiversity hotspot – the Cape Floristic Region, South Africa. Biological Conservation,112: 191–216.

Dinerstein, E., Olson, D.M., Graham, D.J., Webster, A.L.,Primm, S.A., Bookbinder, M.P. and Ledec, G. ,1995. Conservation assessment of the terrestrial ecoregions of Latin America and the Caribbean. World Bank and WWF, Washington D.C.

Halpern, B.S., Pyke, C.R., Fox, H.E., Haney, C., Schlaepfer, M.A. and Zaradic, P. ,2006.Gaps and mismatches between global conservation priorities and spending. Conservation Biology, 20:56–64.

Hoekstra, J.M., Boucher, T.M., Ricketts, T.H. and Roberts, C.,2005.Confronting a biome crisis: global disparities of habitat loss and protection. Ecology Letters, 8:23–29.

Hunter, J.M.L. and Hutchinson, A.,1994. The virtues and shortcomings of parochialism: conserving species that are locally rare but globally common. Conservation Biology, 8:

1163–1165.

IUCN ,1993. Parks for life. Report of the IVth world congress on national parks and protected areas. IUCN, Gland, Switzerland.

James, A.N., Gaston, K.J. and Balmford, A.,1999. Balancing the

Earth's accounts. Nature, 401: 323–324.

James, A.N., Gaston, K.J. and Balmford, A.,2001. Can we afford to conserve biodiversity? Bioscience, 51: 43–52.

Loucks, C., Springer, J., Palminteri, S., Morrison, J. and Strand, H.,2004. From vision to the ground: a guide to implementing ecoregion conservation in priority areas. WWF, Washington D.C.

Luck, G.W., Ricketts, T.H., Daily, G.C. and Imhoff, M. ,2004.Alleviating spatial conflict between people and biodiversity.Proceedings of the National Academy of Sciences USA, 101: 182–186.

Maddock, A. and Du Plessis, M.A. ,1999.Can species data only be appropriately used to conserve biodiversity? Biodiversity and Conservation, 8: 603–615.

Margules, C.R. and Pressey, R.L.,2000.Systematic conservation planning. Nature, 405: 243–253.

Mittermeier, R.A., Robles-Gil, P., Hoffman, M., Pilgrim, J.,Brooks, T.M., Mittermeier, C.G., Lamoreux, J. and da Fonseca,G.A.B. ,2004. Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions. CEMEX, México.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca,G.A.B. and Kent, J. ,2000. Biodiversity hotspots for conservation priorities. Nature, 403:853–858.

Noss, R.F. ,1990. Indicators for monitoring biodiversity: a hierarchical approach. Conservation Biology, 4: 355–364.

Olson, D.M. and Dinerstein, E. ,1998.The Global 200: a representation approach to conserving the Earth's most biologically valuable ecoregions. Conservation Biology, 12: 502–515.

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D.,Powell, G.V.N., Underwood, E.C., D'amico, J.A., Itoua, I.,Strand, H.E., Morrison, J.C., Loucks, C.J., Allnutt, T.F.,Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W.,Hedao, P. and Kassem, K.R. ,2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience, 51:933–938.

Orme, C.D.L., Davies, R.G., Burgess, M., Eigenbrod, F., Pickup, N.,Olson, V.A., Webster, A.J., Ding, T.S., Rasmussen, P.C.,Ridgely, R.S., Stattersfield, A.J., Bennett, P.M., Blackburn,T.M., Gaston, K.J. and Owens, I.P.F. ,2005. Global hotspots of species richness are not congruent with endemism or threat.Nature, 436: 1016–1019.

Pressey, R.L.,1994. Ad hoc reservations: forward or backward steps in developing representative reserve systems? Conservation Biology, 8:662–668.

Ricketts, T.H., Dinerstein, E., Olson, D., Loucks, A., Eichbaum, W.,DellaSala, D., Kavanagh, K., Hedao, P., Hurley, P., Carney,K.M., Abell, R. and Walters, S. ,1999. Terrestrial ecoregions of North America: a conservation assessment. Island Press,Washington, D.C.

Rodrigues, A.S.L., Akcakaya, H.R., Andelman, S.J., Bakarr, M.I.,Boitani, L., Brooks, T.M., Chanson, J.S., Fishpool, L.D.C., da Fonseca, G.A.B., Gaston, K.J., Hoffmann, M., Marquet, P.A.,Pilgrim, J.D., Pressey, R.L., Schipper, J., Sechrest, W., Stuart, S.N., Underhill, L.G., Waller, R.W., Watts, M.E.J. and Yan, X.,2004a. Global gap analysis: priority regions for expanding the global protected-area network. Bioscience, 54:1092–1100.

Rodrigues, A.S.L., Andelman, S.J., Bakarr, M.I., Boitani, L.,Brooks, T.M., Cowling, R.M., Fishpool, L.D.C., da Fonseca, G.A.B., Gaston, K.J., Hoffmann, M., Long, J.S., Marquet, P.A.,Pilgrim, J.D., Pressey, R.L., Schipper, J., Sechrest, W., Stuart,

S.N., Underhill, L.G., Waller, R.W., Watts, M.E.J. and Yan, X.,2004b. Effectiveness of the global protected area network in representing species diversity. Nature, 428: 640–643.

Sanderson, E.W., Jaiteh, M., Levy, M.A., Redford, K.H.,Wannebo, A.V. and Woolmer, G. ,2002.The human footprint and the last of the wild. Bioscience, 52: 891–904.

Soulé, M.E. and Sanjayan, M.A.,1998.Conservation targets: do they help? Science, 279:2060–2061.

Soutullo, A. and Gudynas, E. ,2006.How effective is the MERCOSUR's network of protected areas in representing South America's ecoregions? Oryx, 40: 112–116.

Tear, T.H., Kareiva, P., Angermeier, P.L., Comer, P., Czech, B.,Kautz, R., Landon, L., Mehlman, D., Murphy, K., Ruckelshaus,M., Scott, J.M. and Wilhere, G.,2005. How much is enough? The recurrent problem of setting measurable objectives in conservation. Bioscience, 55: 835–849.

WDPA Consortium,2005.World database on protected areas 2005. IUCN, Gland, Switzerland, and UNEP-WCMC, Cambridge, UK.

Wikramanayake, E.D., Dinnerstein, E., Loucks, C.J., Olson, D.M.,Morrison, J., Lamoreux, J., McKnight, M. and Hedao, P. ,2002.Terrestrial ecoregions of the indo-pacific: a conservation assessment. Island Press, Washington D.C.

Wilson, K.A., McBride, M.F., Bode, M. and Possingham, H.P.,2006.Prioritizing global conservation efforts. Nature, 440:337–340.

WWF,2005.Terrestrial ecoregions of the world (http://www.worldwildlife.org/science/data.cfm, Accessed on 18 October 2005).

SECCIÓN II. MARCO DE TRABAJO PARA EL BUEN GOBIERNO EN LAS ÁREAS PROTEGIDAS. CAPÍTULO 2

Sierra de Nachipitla (México). Foto: V. Urios.

A FRAMEWORK FOR ANALYZING THE GOVERNANCE OF PROTECTED AREAS SINCE AN INSTITUTIONAL PERSPECTIVE.

Mónica de Castro[a],*, Concha Ginestar[b], Vicente Urios[a]

[a] CIBIO- Estación Biológica Terra Natura, Universidad de Alicante, Campus San Vicente del Raspeig s/n, Edificio Ciencias III, 03080 Alicante, Spain

[b] Departamento de Estadística e Investigación Operativa Aplicadas y Calidad, Universidad Politécnica de Valencia, Camino de Vera s/n, 46022 Valencia, Spain

ABSTRACT

This paper propose a theoretical framework of governance of protected areas from an institutional perspective and define good governance of protected areas based on seven principles: legitimacy, inclusiveness, accountability, performance, equity, connectivity and institutional sustainability. These attributes form the institutional basis on which to develop an ecological, social-political and economically sustainable architecture. This holistic approach allows the incorporation of elements associated with the institutional quality that are not sufficiently represented in the current models of assessment of governance in protected areas and to lay the theoretical basis for defining valid governance evaluation models for the global network of protected areas.

Keywords:

Good Governance, Protected Areas, Institutional Quality, Social-Ecological Systems, Collective Action

1. INTRODUCTION

"Governance" is defined as the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken and how citizens and other stakeholders have their say (Graham. et al., 2003). The main role of governance of protected areas is to create and maintain the necessary conditions for efficient management (Abrams et al., 2003).

The increase in the surface, number and diversity of protected areas in the last century, complicates the development and implementation of an efficient management model. There have been numerous studies aimed at developing quality management (Hockings, 2003; Leverington et al., 2010; Stoll-Kleemann, 2010). However, until recently, there has been no interest in defining good governance, which is, ultimately, the structure and the support of the good management.

It is in the last decade that governance of protected areas has gained growing importance in the scientific community and in society. The rapid pace of global biodiversity loss has promoted the adoption of international conventions and agreements in order to stop it. The Convention on Biological Diversity (CBD) is one of the most important political commitments that have been adopted in these terms. At the latest (10th) Conference, the Parties have highlighted the need for detailed studies to improve governance of protected areas, following the guidelines of the work plan of the Strategy 2011-2020 to reduce biodiversity loss (IUCN, 2010).

At the same time, in recent years ecological systems have been growing in complexity. On the one hand, this has increased the number of agents involved, with greater participation in decision-making. On the other hand, the number of relationships between stakeholders and between them and their environment has risen, and thus created conflict. The "top-down" models have evolved to multilevel systems, in which the number and complexity of the processes increases (Brandon and Wells, 1992; Ostrom, 2009, 2010). But they are also very changeable dynamic systems that require adaptive governance models capable of responding effectively to these changes (Folke et al., 2005).

On the other hand, regional particularities of each protected area make it hard to design a general and standardized model for assessing governance of protected areas, and there is therefore a lack of data on their current situation. We believe that a broader perspective of governance of protected areas, understood as a part of the institutional framework, can provide sufficient homogeneity as to serve as a basis for a universal assessment model for the network of protected areas of the world.

The studies that have analyzed the governance of protected areas to date have been defined mainly from an environmental perspective, forgetting to incorporate some aspects that define the institutional component of governance. Until recent years, inadequate attention has been paid to the importance of institutions, and the compatibility of conservation policies with the institutional setting within which they operate, must be analysed. Incorporating institutions increases the chance that implemented policies will have the intended consequences of promoting conservation and sustainable use (Smith et al., 2003; Stoll-Kleemann et al., 2006). In addition, the institutional component appears to directly influence the economic impact. It has been demonstrated that aid accelerates growth in developing countries with sound institutions and policies, but has less or no effect in countries in which institutions and policies are poor (Burnside and Dollar, 2004). This question is particularly interesting if we consider that priority conservation areas are mainly in developing countries (Soutullo et al., 2008), where the results of governance are usually lower (Kauffman et al., 2010).

The framework we propose will help identify relevant variables in the governance of protected areas using an inclusive concept of governance, in which an environmental perspective, providing elements of support for the achievement of conservation objectives and an institutional perspective, providing elements of a culture of good government complement each other. The aim is to establish a framework for good governance of protected areas from an institutional perspective and to present the main components of a quality governance of protected areas. We present this proposal to serve as a starting point for further work aimed at evaluating and improving governance of the protected areas of the world.

2. PROTECTED AREAS AS SOCIAL-ECOLOGICAL SYSTEMS (SESs)

In many cases, the work on governance issues of protected areas the contextual variables have traditionally been considered exogenous variables, which have not been given much importance. In addition, in the current social context of globalization, technological and environmental development makes it necessary to design holistic global public policy strategies able to bridge the gaps between the sustainable development capacity of developed and developing countries (Udo and Jansson, 2009).

Some studies have defined a SES as an ecological system intricately linked with, and affected by, one or more social systems (Anderies et al., 2004; Ostrom, 2009).

In this paper we consider protected areas as SES, where ecological, economic, political and social agents are involved and also interact with each other.

On the other hand, International Commitments about Human Development such as the Millennium Development Goals and Human Development Report noted the need to improve governance at all levels (UNDP, 2011). These institutional statements are the result of intense political negotiations (Hulme and Scott, 2010) and are a clear example of how international governance raises global challenges which must be addressed when designing efficient governance models in specific contexts, as, for example, in this case of protected areas.

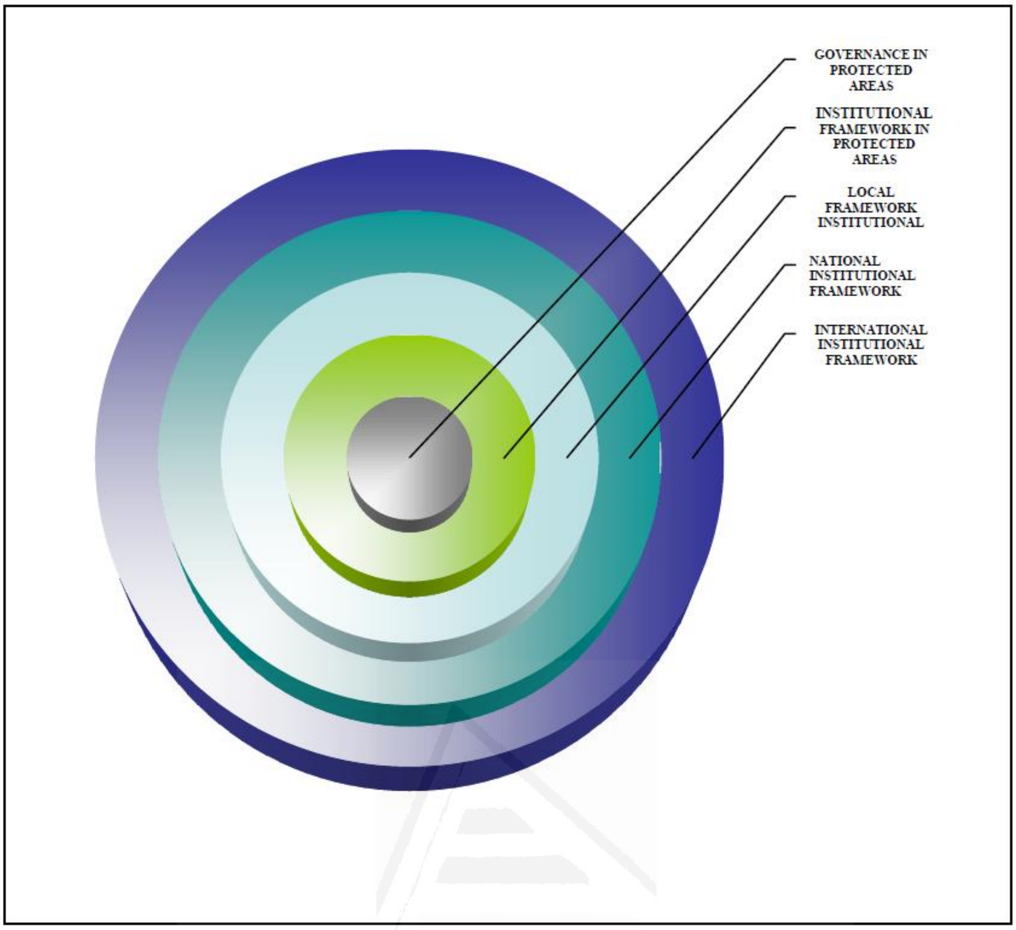


Figure 1. Institutional Framework and Governance in Protected Areas

Protected areas are not related to the institutional framework or political and social context, but are part of the institutional framework, i.e. the social architecture which implements the rules of the game. The relation is inclusivity and not interaction (Figure 1).

Protected area, from this perspective, is one level more of governance, included in the international, national or regional institutional framework (Borrini-Feyerabend, 2003; Mansourian and Oviedo, 2009). On the other hand, the relationship between the inclusiveness of governance and institutions is generally well defined in the area of social sciences.

However, the study of environmental science relationship is not so clear. In the next section we will describe this relationship.

3. AN INSTITUTIONAL PERSPECTIVE: GOOD GOVERNANCE, INSTITUTIONAL QUALITY AND THE LOGIC OF COLLECTIVE ACTION

In this section we review the concept of Governance, Institutional Quality and Collective Action from the Institutional Framework.

The World Bank (WB) defines governance as the traditions and institutions by which authority is exercised in a country for the common good. The United Nations Development Programme (UNDP, 1997) defines governance as ―the exercise of economic, political and administrative authority to manage a country's affairs at all levels. It comprises mechanisms, processes and institutions, through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences‖. Foucault (1972) identifies governance with the relationship between institutions and citizen participation.

In all of them a structure of more or less complex power relationships between the social agents for decision making is considered.

Institutions are the humanly devised constrains that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions and codes of conduct) and formal rules (constitution, laws and property rights) (North, 1990).

Institutional change refers to changes in the rules that structure these relationships. In the case of protected areas, changes in these rules, formal or informal, such as globalization, generate tensions between local governance and other higher levels, especially national (Alcorn et al.,2005).

Figure 2 depicts the relationship between Institutional Quality, Collective Action and Good Governance in protected areas, which is explained below.

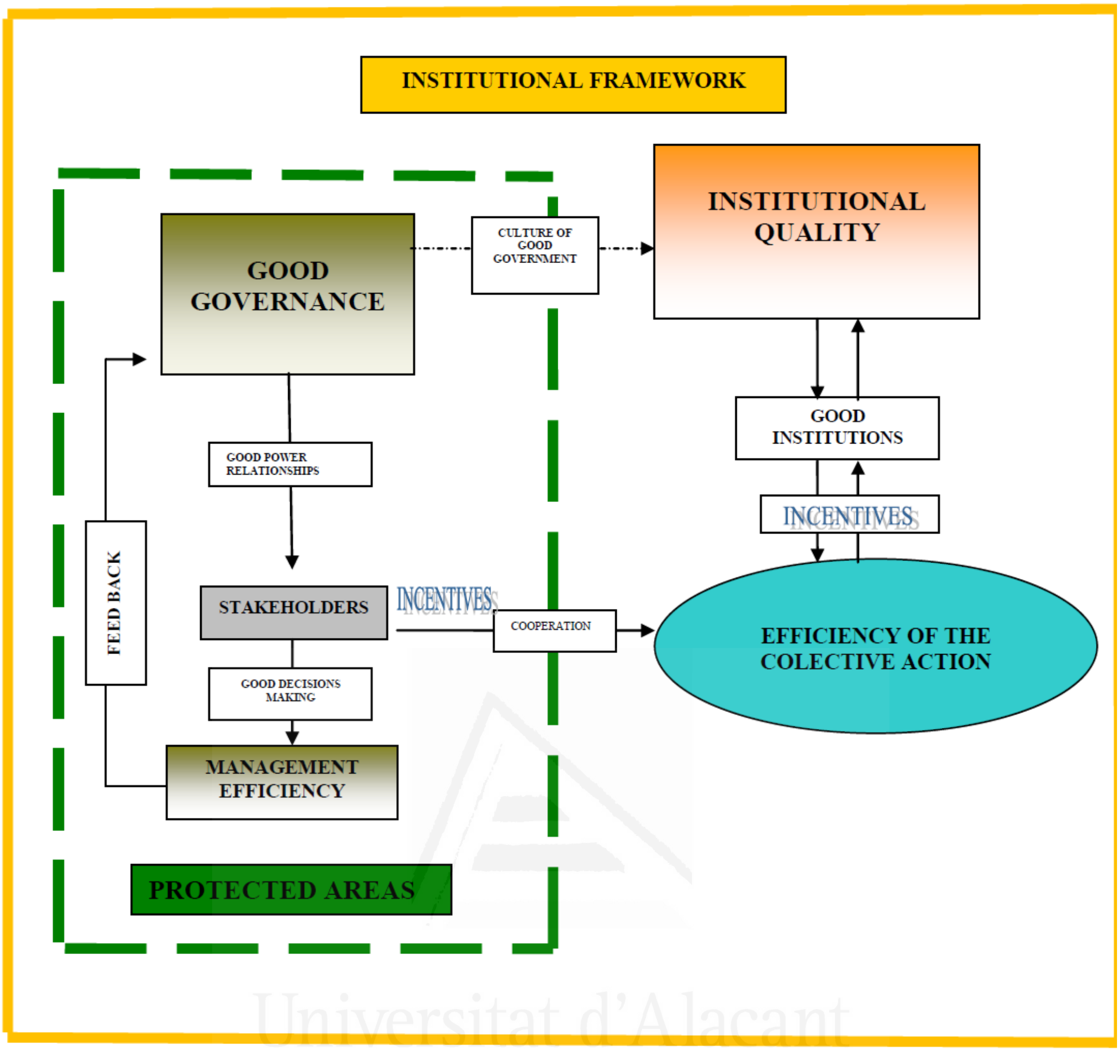


Figure 2. Good Governance in Protected Areas, Institutional Quality and Collective Action

The Institutional Framework displays two basic economic functions: on the one hand it reduces transaction costs and, on the other, facilitates the coordination of the agents (Alonso and Garcimartin, 2008).

The relationship between the Efficiency of Collective Action and Institutions of Quality is twofold: Firstly, an institution is a response to articulate collective action, and secondly, the institution itself is the result of collective action (Alonso and Garcimartin, 2008). One of the main functions of the institutions is to create incentives for agents in order to achieve this "social optimum".

The theory of collective action tries to determine "the collective results in terms of individual motivations" (Hardin, 1982). In turn, it has been observed that determining variables of the quality of institutions, such as reputation, trust and reciprocity positively affect the efficiency of collective action (Ostrom, 2010).

An application of the collective action theory applied to open access goods is the tragedy of the commons. This theory explains the problems arising from the indiscriminate and irresponsible use of common resources whose users are trapped in an accelerated overuse as consequence of the property rights not being adequately defined, since they do not need to invest time and energy to extract themselves and demonstrates the difficulty that agents have to achieve the common good through effective collective action (Hardin, 1968; Ostrom, 2009).

This pessimistic view of the inevitable destruction of common resources has been challenged by empirical studies from various disciplines that have concluded that resource users have invested in designing and developing governance systems for their sustainability (Ostrom, 2009).

Using game theory, the problems derived from collective action occurs when individuals choose actions in a situation of interdependence. If each individual selects strategies based on maximizing short term profits, individuals will choose actions that will lead to a worse outcome than the whole could have achieved. In this case, the Nash equilibrium for a simple iteration would be the socially optimal outcome. This result could be achieved if the players choose cooperation strategies (Ostrom, 1990, 2000).

In the last two decades it has been shown that in many areas, management by local communities can be more efficient than other types of management (Alcorn, 1993,2010; Borrini-Feyerabend, 2003; Hayes, 2006; Ostrom,1999; Shahabuddin and Rao, 2010).

For this reason, we have considered the participation of local communities, as one of the most important in defining good governance of protected areas. On the one hand, they are the users of the resources and they are the ones who get benefit from these. But they also have the experience and knowledge to optimize the performance of these resources (Ostrom et al.,1999). However, it needs some prerequisites for this to happen. Ostrom (1999) points out as prerequisites for the success of this system a series of institutional conditions necessary to develop appropriate incentives to act upon the behaviour of agents. These incentives are consolidated in the long-term and they are part of the "culture" that governs the operation of the complex socio-economic, political and ecological and intrinsic part of institutional quality.

The institutional failure is derived from problems such as a mismatch between the ecological and socio-economic scale, that occurs as a result of a weak feedback between decision making agents and their natural environment and this leads to inappropriate incentives and a poor and inefficient legal framework for protected areas.

The protected area is part of an SES and therefore is "contained" within an institutional framework, i.e. the social, economic and political architecture which implements the rules of the game. Its boundaries are permeable to many variables that belong to the institutional, political, economic and social framework, which was initially considered outside of the study of the conservation of the ecosystems.

On the one hand, we reach two goals related to the institutional framework: i) on one hand, the design of a good governance constitutes a "Culture of Good Government" which will support and be part of the Institutional Quality and ii) on the other hand, good power relationships will allow incentives for agents to choose cooperation strategies and thus achieve an Efficient Collective Action to be generated (Vollan and Ostrom, 2010).

In conclusion, good governance in protected areas contributes to the improvement of institutional quality, building a "culture of good government" and also creates power relationships capable of stimulating cooperative strategies between agents involved in the protected area. In this multiscale system, the quality of governance of protected areas sets up the institutional basis for developing a sustainable ecological, social, political and economic architecture, and the basis for efficient management that will allow the achievement of the social and conservation objectives of the protected area.

4. DESIGN OF THE PRINCIPLES OF GOOD GOVERNANCE IN PROTECTED AREAS

As we have just seen, governance of protected areas is determined by a conservationist ecological dimension and an institutional political dimension. To date, the attributes that define good governance of protected areas have been primarily based on ecological criteria.

However, we have identified some improvements to these models related to the institutional dimension of the concept of governance which is described in this section.

To define our conceptual framework, we review not only other theoretical frameworks on governance in protected areas (Abrams et al., 2003; Borrini-Feyerabend, 2003;

Graham et al., 2003; Griffith et al., 2009; Lockwood et al., 2009; Lockwood,2010; Mansourian and Oviedo,2009), but also analyze trends in governance and institutional change(Alcorn et al., 2005; Balloffet and Martin, 2007; Dearden et al., 2005 Tarschys, 2001). We review theoretical frameworks about SES (Anderies et al., 2005; Ostrom, 1990, 1999, 2000) and the indicators of good governance of the World Bank, Transparency International and World Economic Forum (IIED, 2012; Kauffman et al., 2009; Kurzman et al., 2004; Schwab, 2011; Transparency International, 2011).

The "new governance" in protected areas is characterized by greater involvement of nongovernmental agents, not previously included in the decision-making processes and in a greater decentralization of these processes. It also encourages greater use of formal mechanisms of accountability as a result of numerous legislative and political changes and a greater amount of funds from a greater diversity of sources (Dearden et al., 2005; Howlett and Rainer, 2006; Kothari, 2008).

This new integrated approach provides a good opportunity for the expansion of the democratic space and for strengthening the institutional structures. However, in this context, the complex decision-making processes, with strong conflicts of interest and a large number of stakeholders, such as those that relate to protected areas, are difficult to manage. It is appropriate, therefore, to design governance evaluation models adapted to this new reality.

Early work on governance of protected areas (Abrams et al., 2003; Borrini-Feyerabend, 2003; Graham et al., 2003) designed the principles of good governance, adopting, as the basis of good governance, the principles of the United Nations UNDP. These works constitute a solid base that serve as the basis for further analysis. Lockwood proposes some modifications to these principles, adapting them to the characteristics of the "new governance", attaching greater importance to issues such as participation and equitable representation of all stakeholders and also to the coordination of interactions between agents both within and between levels.

In Table 1 we propose a framework where we consider certain principles of the framework of the IUCN (Abrams et al., 2003; Graham et al., 2003) and Lockwood updates (Lockwood, 2010). Our framework introduces an institutional perspective to define good governance of protected areas.

Our contributions are: 1) the dimension of the Performance concept is amended, 2) greater importance is attributed to the permanence of the institutions of the protected area in time, adding the dimension "Institutional Sustainability", 3) Institutional Diversity and Institutional Distance are incorporated in all dimensions as a fundamental component of governance and 4) a different method to measure performance and perceptions is proposed for each dimension.

1) A new concept of "Performance": The first important contribution is a new approach to the dimension "Performance". We understand "Performance" as the ability of the governance system to provide incentives to the agents to adopt cooperative strategies.

2) "Institutional Sustainability": The "Institutional Sustainability" dimension includes matters

relating to resilience, or the capacity of institutions to adapt to environmental changes and external threats and, to the same extent, incorporates institutional robustness, which refers to the ability of an institution to maintain certain characteristics stable over time. This dimension measures the balance between the flexibility and the stability of the governance.

3) Institutional Diversity and Institutional Distance: We also include Institutional Diversity and Institutional Distance as key elements that must be present in all dimensions of governance of a protected area. Institutional Diversity refers to the variety of institutional representation at a horizontal level, i.e. at the same level of authority. Institutional Distance refers to vertical power relationships and represents the distance between an element and its higher levels of authority. Institutional diversity can be as important as biological diversity for the sustainability of common resources (Ostrom et al., 1999). The knowledge and proximity to resources and agents of governance of the protected area must be supplemented by institutional distance to provide fairness to the processes and an additional protection of common resources. Thus it adds an institutional protection from the top and allows the control of the lower levels with more impartiality. This institutional distance is determined by: i) the international governance of protected areas set by the legal framework, international agreements and relationships, to achieve specific objectives in each protected area, which

cannot be achieved without the global agreement of the communities and by ii) the international institutional framework, set by the legal framework, agreements and international relations, which relate to economic, political and social objectives.

Good governance should ensure a minimum of horizontal institutions and a minimum distance between them, vertically, in all dimensions.

4) Performance and Perceptions: There are two types of components of good governance, an objective component, which includes speeches, negotiations, mediation in conflict resolution, public consultation procedures, protests and other processes related to decision making based on quality criteria. But there is also a very important subjective component, based on the perception and satisfaction of actors on governance, which includes ethical aspects. On the one hand, agents must reliably understand what their power structures are and how the decision-making processes work in the protected area in order to be able to react (or not). On the other hand, the degree of satisfaction of the agents may be an indicator of the culture of good government in the area. A high degree of satisfaction with governance based on quality principles encourages cooperative strategies between agents, and will therefore be an important contributor to efficient collective action. However a high degree of satisfaction with poor quality governance, for example based on corrupt behaviour among agents, or discriminatory decision-making processes, shall constitute a serious obstacle in the process of collective action. The subjective component is very important, as it will determine the predisposition, behaviour, and long-term culture of government agents. Moreover, the subjective component is the major source of the conflict among stakeholers for assessing good governance of protected areas (Eagles et al., 2010).

Both objective and subjective components, refer not only to interactions between governmental actors, but also to interactions between all those involved in the protected area, such as NGOs, private companies, land owners, local associations, indigenous populations or local communities. It is also important to consider the "informal" rules and not only the formal ones.

The dimensions of the good governance of protected areas are defined by seven principles (Table 1): Legitimacy, Inclusiveness, Accountability, Performance, Equity, Connectivity and Institutional Sustainability.

ATRIBUTES	PRINCIPLES
LEGITIMACY	Integrity, commitment and responsability Authority and representation Credibility and trust Consensus Orientation
INCLUSIVENESS	Participation Representation
ACCOUNTABILITY	Transparency Generation, access and use of information Assigning of roles and responsabilities
PERFORMANCE	Planning Self-organized Games rules or regulatory framework quality Reciprocity Alignment with conservation objectives
EQUITY	Decency /Human Rights No Discrimination and opportunities Impartiality of the games rules
CONNECTIVITY	Horizontal Connectivity Vertical Connectivity Subsidiarity
INSTITUTIONAL SUSTAINABILITY	Resilience Robustness

Table 1. Dimensions of Good Governance of Protected Areas from an Institutional perspective (Source: Own elaboration based on Abrams, Graham and Lockwood)

4.1. LEGITIMACY

Legitimacy includes characteristics and perceptions related to the acceptance of the authority of an institution to govern, the integrity and responsibility with which it exercises power and the credibility and trust that agents have in this. It also includes the authority and representativeness and consensus orientation (Abrams et al., 2003).

Moreover, we consider a legislative or regulatory framework to recognize and allow freedom of association, freedom of expression and other features of democratic systems. This dimension includes features that indicate that the authority is accepted and respected.

4.1.1. Integrity, Commitment and Responsibility

This item includes the degree of involvement of the governing body and the degree of compliance of its commitments with accountability and integrity.

4.1.2. Authority and Representation

This concept is closely linked to democratic processes that legitimize the formation of governments (Lockwood, 2010). However, sometimes, in the absence of democratic systems, the legitimacy of authorities is determined by aspects such as regularity of the procedures and the incorporation of issues related to democratic systems, such as financial accountability or transparency. The question is knowing the limits of legitimacy in these systems of "indirect democracy" (Dovers, 2005; Moore, 2005).

4.1.3. Credibility and Trust

Credibility and Trust among agents are variables that significantly affect their legitimacy (Abrams et al., 2003; Graham et al., 2003; Kauffman et al., 2009; Alonso and Garcimartin, 2008, 2010). This feature may appear to be associated with the persistence over time of the governing body, however we must be careful, because if there are problems of corruption (Accountability), we obtain unreliable results. This problem can be avoided by increasing transparency in the processes.

4.1.4. Consensus Orientation

The strength of leaders, achieving results and achievement of broad consensus, may be factors influencing institutional legitimacy (Newman et al., 2004). Consensus orientation and ability to negotiate and come to formal or informal agreements has great material impact on the acceptance of authority by agents.

4.2. INCLUSIVENESS

Inclusiveness refers to the opportunities of the agents to participate in decision-making processes and actions in an influential manner (Lockwood, 2009).

One of the strongest trends in governance in the last decade has been a growing presence of all actors in decision-making processes, especially local communities decentralizing the governance model and incorporating new agents to decision-making processes and introducing a wide range of participatory techniques (Conrad et al., 2011; Dearden et al., 2005; Kothari,2008; Schultz and Duit, 2010).

4.2.1. Participation

The governing body must ensure and promote the participation of all stakeholders, ensuring respect and non-discrimination in decision-making processes.

4.2.2. Representation

The power-sharing should be developed equally among all agents. In analyses conducted at the local level, it has been reported that far from showing positive externalities, imbalances in the distribution of power generate undesirable effects (increased environmental degradation) (Perez-Cirera and Lovett, 2006).

4.3. ACCOUNTABILITY

Accountability measures the clarity, accessibility and timeliness with which members of the governing body accept and justify their responsibilities. It also considers the transparency of the processes (Abrams et al., 2003; Graham et al., 2003; Lockwood, 2010).

Accountability covers issues such as clarity in the allocation and acceptance of roles and responsibilities and clearly defining the scope, influence, accessibility and clarity of information to all actors, the transparency of economic policy and lack of corruption.

4.3.1. Transparency

The ability of citizens and civil society to access information relevant to the operation of the protected area and its regulations, budgets and expenses and other issues related to decision making processes (Abrams et al., 2003; Graham et al., 2003). In addition, decision making processes are subject to open scrutiny by the agents (Lockwood et al., 2009).

4.3.2. Generation, access and use of information

The capacity of the protected area as an institution to generate information relevant to decision making, to facilitate access to and to promote the use of the information.

4.3.3. Assigning of roles and responsibilities

The governing body accepts its responsibilities and these are clearly defined (Abrams et al.,2003; Graham et al., 2003; Lockwood, 2010).

4.4. PERFORMANCE

The governance system works if it is able to generate appropriate incentives for efficient collective action, i.e. to create cooperation strategies between the agents to resolve conflicts.

The objective of good governance is to ensure that the way in which authority is exercised, the power and responsibilities of individuals and organizations will be capable of creating a "culture of good government" where agents understand and assume as their own the protected area objectives, engage in processes and are able to organize.

Furthermore, the system of governance must be able to develop efficient mechanisms to generate financial resources.

The governance system must consider the social and conservation objectives of the protected area. This theoretical framework does not consider elements that belong to management, such as leadership or performance, but it is essential to establish and maintain a permanent feedback to provide information on management processes.

4.4.1. Planning

It is essential to incorporate the principles of good governance into the design processes and the program planning, fostering a culture of administrative simplification or bureaucratic quality (Kauffman et al., 2010), an equitable distribution of costs and benefits among all stakeholders and that all agents know and understand the objectives of the protected area. This refers to the "culture of good government."

4.4.2.”Self-organized”

In this point we evaluate the ability of the agents and society to organize and promote collective actions. The ability to associate and the ability for group action are related to the "Effective Leadership" models proposed by Abrams et al., (2003) and Graham et al., (2003).

It is, however, a broader concept that includes collective aspects and refers not only to individual aspects but to the structure of the group as an institution, and therefore we believe that is not a management element, rather it is part of the institutional structure of the protected area. This aspect is related to a regulatory framework that allows and ensures the formation and continuity of these organizations.

4.4.3. Regulatory Quality

Measures the ability of the protected area to generate regulatory frameworks that effectively influence the behaviour of stakeholders. There must be a well defined and non-contradictory legal and regulatory framework to ensure that the protected area functions as an institution of quality.

The existence of a graduated and effective system of sanctions is necessary to encourage the cooperation strategies. Otherwise, "free-rider" behaviour will appear which would displace the socially optimal equilibrium (Ostrom et al., 1999).

Property rights must also be clearly defined and regulated by a clear legislation without inconsistencies. This is necessary for the institution to operate (Anderies et al., 2004; Ostrom, 2009, 2010)

4.4.4. Reciprocity

Reciprocity refers to the institutional efficiency and it is achieved when the distribution of costs and benefits of the system are distributed equitably and fairly among all agents (Ostrom, 2000). Moreover, in situations of strong reciprocity it has been observed that cooperation in heterogeneous groups is stable over time (Bowles and Gintis, 2003).

In protected areas, we can often find common problems related to financial compensation losses resulting from human-wildlife conflict. In developing countries, there are often significant costs associated with living on the edge of a protected area. These costs can be a loss of access to traditional resources, loss of social, environmental and political autonomy, and an increase in threats to property rights over resources that are not always distributed equally among all agents (Bagchi and Mishra, 2006). It has been observed that some of the most important problems are the delays in the legislative processes, inadequate remuneration and corruption problems (Ogra and Badola, 2008).

Moreover, when incorporating the preferences of all stakeholders in decision-making processes new scenarios for allocating costs and benefits more efficiently in terms of ecology and economics may appear (Thyl de Lopez, 2003).

Reciprocity in protected areas is not only about economic issues, but also about the importance of the conservation of landscapes, the health of natural resources and conservation of biodiversity and the value that agents give to these aspects (Pavoola, 2005). But in developing countries, where approximately 11.3% of the land area is protected (IUCN and UNEP-WCNC, 2011) the issues of property rights and economic losses are those that generate more and worse conflict.

4.4.5. Alignment with conservation objectives

For good governance of a protected area to be effective, it must be consistent with the elements of management. To make this possible, it is necessary that there are mechanisms for ongoing communication and return between the governance and management dimensions. In other words, the objective of good governance is "how do things so that decisions are taken properly," but in the context of a protected area, the goal is "how to do things so that decisions are both taken properly and conservation objectives are achieved".

4.5. EQUITY

Equity involves equality of opportunity for all men and women to improve their welfare and the existence of a legal framework to ensure fairness and to defend and regulate those rights.

The decision-making processes are designed and developed with decency, respect for human rights and without humiliating any of the agents (Graham et al., 2003) is adopted as base the principle of "do no harm".

An associated aspect of equity is the equitable distribution of costs and benefits derived from the conservation among all agents (Abrams et al., 2003; Graham et al., 2003; Lockwood, 2010). However, from our approach, this aspect is best defined as "Reciprocity" in the dimension "Performance" because it is related to the institutional efficiency of the protected area.

4.5.1. Decency

Concerning respect for human rights and all points of view, traditions and customs in the protected area (Abrams et al., 2003; Graham et al., 2003; Lockwood, 2010).

4.5.2. No discrimination and opportunities

The governing body must not discriminate against any group (Abraham et al., 2003; Graham et al., 2003; Lockwood, 2010).

4.5.3. Impartiality of the game rules

The game rules must be fair to all stakeholders and citizens (Abraham et al., 2003; Graham et al., 2003). This includes laws, norms and other non-binding instruments such as agreements.

4.6. CONNECTIVITY

The evolution of SES, common resources, institutions and governance tend to be increasingly complex. This new stage with new agents and new interactions and with various levels of authority requires good coordination and communication for the governance to function properly.

The connectivity measures the communication and coordination in the interactions mainly
deriving from the decision-making processes, between different levels of governance (inter-level connectivity) and between the different actors involved in the protected area (intra-level connectivity) and the alignment of priorities, plans and activities between organizations on governance (Lockwood, 2010).

4.6.1. Horizontal Connectivity

Intra-level Connectivity measures the ability of agents to develop effective mechanisms for communication and coordination to avoid duplication and identify synergies. In short, it measures the cooperative ability between various stakeholders in the protected area. It may sometimes be useful to incorporate new agents to facilitate connectivity.

Several studies indicate the importance of independent external organizations and NGOs as mediators in systems of governance in forest management in complex contexts in developing countries (Hayes and Persha, 2010).

4.6.2. Vertical Connectivity

Increased interactions with different levels of government, both political and geographical, as a precondition for reaching a sustainable development, makes it necessary to pay more attention to communication and coordination between different scales (Clark and Clarke, 2011; Lemos and Agrawal,2006; Lockwood , 2010; Oakerson and Parks, 2011). Inter-level connectivity deals with this aspect. The aim is to avoid duplication, inconsistencies and administrative, legislative, political and ecological overlapping among the various levels.

4.6.3. Subsidiarity

One method of inter-level connectivity is the Subsidiarity, to which we will pay special attention. Subsidiarity is the delegation of authority in the decision-making processes at lower levels of government.

Stakeholders closer to the resources are those with more traditions and knowledge about the best way to manage them and more information about their status, availability and problems. On the other hand, the major conflicts usually occur at the regional level and "failure" in governance has greater effects at this level so it is appropriate that there is a strong connectivity between local and national levels (Duran et al., 2011).

Good governance must delegate sufficient authority to regional and local levels because they are the ones with more information on resources and have a greater capacity to resolve conflicts in the protected area, but we need to develop effective control from higher levels of authority. This control refers to Institutional Distance.

4.7. INSTITUTIONAL SUSTAINABILITY

Refers to characteristics resulting from the protected areas as long term institutions. Their ability to adapt to the changing environment and the permanence of certain characteristics in a stable way despite changes in the environment, which give identity to the area from an institutional perspective. It measures the balance between agility providing resilience *("self-reflexivity")* and the stability provided by the institutional robustness *("self-enforcement").*

The main challenge of Institutional Sustainability is to correctly identify the structural and non structural elements of the governance.

4.7.1. Institutional Resilience

Resilience includes aspects which measure the ability of institutions to anticipate changes in society and the environment and the ability to reduce the uncertainty associated with human interaction through mechanisms of evaluation and learning. A resilient social-ecological system can transform a crisis situation into an opportunity to improve (Folke et al., 2005).

Refers to the "adaptability" of governance ("self-reflexivity").

It also provides flexibility to an organization or institution to external changes, such as the return of responsibilities to local and regional authorities, around a stable structure that remains fixed in time (Baral , 2012).

Good governance should contemplate administrative, legislative, political and economic restructuring mechanisms. It must also have the ability to generate and use information more effectively and have systems of learning, evaluation mechanisms and mechanisms for the implementation of the evaluation (Griffith et al., 2003; Lockwood, 2010). The main challenge for the resilience of a SES is to reduce uncertainty in an increasingly dynamic and unpredictable environment.

In this point we must be careful with resilience management as interventions in SESs with the aim of immediately altering resilience can cause confrontations over issues of governance (Lebel et al., 2006).

4.7.2. Institutional Robustness

Institutional Robustness refers to the character of an institution which is maintained over time, giving it identity and allowing it to build an institutional culture by itself, around which can other non-structural elements can be modified. Refers to the stability of governance *("self-enforcement").*

It has been observed that in the context of conservation of the commons, communities that have been formed slowly and have an important cultural tradition have proved to be more institutionally efficient (Ostrom, 2000). Since collective action is largely based on mutual trust, some self-organized resource regimes in rapid settlement areas have disintegrated within relatively short periods (Clements et al., 2010**).**

Robustness measures the stability of the institutional framework within which standards and formal and informal laws of the protected area are developed, the clear assignment of property rights and long-term security offered by the protected area as an institution. It also refers to the value given to the traditions, knowledge and customs of local populations, through the maintenance of determined institutions.

5. CONCLUSIONS

In this paper we have presented a theoretical framework that defines good governance of protected areas from an institutional perspective, which could be useful when designing evaluation models of governance applicable to the global network of protected areas.

We have based our work upon the frameworks presented so far, studying the trends shown in governance over the past two decades. We present an overview of work at the institutional framework level and incorporate factors that affect the efficiency of collective action.

In this framework we analyze the elements that define good governance, without regard to management aspects. However, we note the importance that governance and management function as an integrated system has, to achieve the social goals and the conservation of protected areas.

Our main contribution is the incorporation of elements that consider the efficiency of the institutional function of the protected area as part of a SES, in this way encouraging cooperative behaviour among stakeholders in the area.

Thus, our framework attaches particular importance to i) the participation and representation of all actors in decision-making processes, assessing the participation and representation of stakeholders in a single dimension: "Inclusiveness" ii) the consistency and communication between actors in the same level and different levels of authority, through the dimension "Connectivity" iii) the ability of the protected area as an institution to generate cooperative behaviour between agents and to create a "culture of good governance" capable of generating an effective collective response, iv) institutional sustainability of the protected area, i.e. their ability to persist in time, developing and maintaining flexibility mechanisms and maintaining stable those institutional characters that will define its own identity and allow the development and maintenance of the traditions, knowledge and customs of the local population, v), the institutional diversity and institutional distance are the basis of good governance and vi) the evaluation of governance differing Performance and Perceptions.

Our framework is a theoretical model that provides a wider perspective and can serve as a basis for developing empirical analysis aimed at assessing and improving the current state of governance in the global network of protected areas.

REFERENCES

Abrams, P., Borrini-Feyerabend, G.,Gardner, J. and Heylings, P., 2003. Evaluating

Governance. A Handbook to accompany a participatory process for a protected area. PARKS CANADA and TILCEPA—Theme on Indigenous and Local Communities, Equity and Protected Areas of IUCN CEESP /WCPA.

Alcorn, J.B.1993. Indigenaous People and Conservation. Conservation Biology 7, 424-426.

Alcorn J.,B, Luque, A. and Valenzuela, S.,2005. Global Governance and Institutional Trends Affecting Protected Areas Management: Challenges and Opportunities Arising from Democratization and Globalization Durban, South Africa: Governance Stream of the Vth World Parks Congress; 2005.

Alcorn J. ,2010. Indigenous People and Conservation. Theme on Governance, Equity , and Rights of the World Conservation Union Commission on Environmental, Economic , and Social Policy. McArtur Foundation White Paper Series.

Alonso, J.A. and Garcimartin,C. ,2008. Acción Colectiva y Desarrollo. El papel de las

instituciones. UCM Editorial Complutense.

Alonso, J.A. and Garcimartín, C., 2010. The Determinants of Institutional Quality. More on the Debate, Journal of International Development. DOI: 10.1002/jid.1710.

Anderies, J.; Jassen, M.A. and Ostrom, E. ,2004. A Framework to Analize the Robustness of Social-ecological Systems from an Institutional Perspective. Ecology and Society (9) 1, 18.

Balloffet, N.M. and Martin, A., 2007. Governance Trends in Protected Areas: Experiences from the Parks in Peril Program in Latin America and the Caribbean. The Nature Conservancy, Arlington, Virginia, USA.

Bagchi, S., and Mishra, C., 2006. Living with large carnivores: predation on livestock by the snow leopard (Uncia uncia). Journal of Zoology 268(3), 217–224.

Baral, N., 2012. Empirical analysis of factors explaining local governing bodies' trust

for administering agencies in community-based conservation. Journal of Environmental Management 103, 41-50.

Barret, C.; Brandon K.; Gibson, C.C. and Gjertsen, H. 2001. Conserving tropical

biodiversity amid weak institutions. BioScience 51, 497-502 .

Borrini-Feyerabend, G., 2003. Governance of protected areas-Innovation in the air.

IUCN/CEESP Journal Policy Matters, Issue 12, Community Empowerment for Conservation, Sep. 2003.

Bowles, S., and Gintis, H., 2003. The evolution of strong reciprocity: cooperation in

heterogeneous populations. Theoretical Population Biology 65, 17-28.

Brandon, K.E. and Wells, M., 1992. Planning for People and Parks: Design Dilemmas. World Development 20 , 557-570.

Burnside, C. and Dollar, D., 2004. Aid, policies, and growth: Revisiting evidence. Policy Research Paper nº 2834, World Bank.

Clark, J.R.A. and Clarke, R ., 201. Local sustainability initiatives in English National Parks: What role for adaptive governance? Land Use Policy 28, 314-324.

Clements ,T., John, A., Nielsen, K., An, D., Tan, S. and Milner-Gulland, E.J.,2010.

Payments for biodiversity conservation in the context of weak institutions: Comparison of three programs from Cambodia. Ecological Economics 69, 1283-1291.

Conrad, E., Christie, M and Fazey, I., 2011. Is research keeping up with changes in landscape policy? A review of the literature. Journal of Environmental Management 92, 2097-2108.

Dearden, P.,Bennett,M. and Johnston, J., 2005. Trends in Global Protected Area Governance, 1992-2002. Environmental Management Vol 36: 89-100.

Dovers, S. ,2005. Clarifying the Imperative of Integration Research for Sustainable Environmental Management. Journal of Research Practice 1: M1

Duran, E.,Bray, D.B., Velazquez, A.and Larrazabal, A., 2011. Multi-scale Forest Governance, Deforestation, and Violence in Two Regions of Guerrero, Mexico. World Development 39, 611-619.

Eagles, P., Havitz M., McCutcheon, B.,Windekind Buteau-Duitschaever and Glover, T., 2010. The Perceived Implications of an Outsourcing Model on Governance within British Columbia Provincial Parks in Canada: A Quantitative Study. Environmental Management 45, 1244–1256.

Folke, C.; Hahn, T.; Olsson, P. and Norberg, J. , 2005. Adaptative Governance of Social- Ecological Systems Annual Review of Environment and Resources 30, 441-473.

Foucault, M., 1972. The Archaeology of Knowledge. London: Tavistock Publications.

Graham, J, Amos, B and Plumptre, T., 2003. Governance Principles for Protected Areas in the 21st. Century. Fifth World Parks Congress, South Africa in September 2003.

Griffith, R, Davidson, J and Lockwood, M., 2009. NRM Governance for change: Revisiting good governance through an adaptative lens. Land and Wate Australia, April 2009.

Hardin, G., 1968. The tragedy of the commons. Science 162, 1243-1248.

Hayes T., 2006. Parks, People, and Forest Protection: An Institutional Assessment of the Effectiveness of Protected Areas. World Development 34, 2064-2075.

Hayes, T. and Persha, L., 2010. Nesting local forestry initiatives : Revisiting community forest management in a REDD + world. Forest Policy and Economics 12, 545-553.

Hockings,M. (2003). Systems for Assessing the Effectiveness of Management in Protected Areas. BioScience 53, 823-832.

Howlett, M., and Rayner, J., 2006. Convergence and divergence in new governance arrangements: evidence from European integrated natural resource strategies. Journal of Public Policy 26 (2), 167–189.

Hulme, D and Scott, J., 2010. BWPI Annual Report.

IIED , 2012. http://www.iied.org/governance/home Accesed in January 2012

IUCN, 2010. Enhancing the contribution of Protected Areas to Biodiversity Conservation .The role of the CBD Programme of Work on Protected Areas (POWPA) Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD COP10), 18-29 October, 2010, Nagoya, Japan.

IUCN and UNEP-WCMC, 2011. The World Database on Protected Areas (WDPA): January 2011. Cambridge, UK: UNEP-WCMC.

Kaufman, D.; Kraay, A. and Mastruzzi, M., 2009. Governance Matters VIII-Aggregate and Individual Governance Indicators 1996-2008. Policy Research Working Paper. TheWorld Bank.

Kothari, A., 2008. Parks 17: Protected areas and people: the future of the past. Nº 2 Durban +5.

Kurtzman,J, Glenn, Y. and Phumiwasana, T., 2004. The global costs of opacy. MIT Sloan Management Review-October 2004.

Lebel,L., Anderies, J.M.,Campbell, B.,Folke, C.Hatfield-Dodds,S.Hughes, T.P. and

Lemos, M.C. and Agrawall, A., 2006. Environmental Governance. Annual Review.

Environmental Resources 31, 297–325.

Leverington, F., Lemos Costa, K., Pavese, H., Lisle, A.and Hockings, M .2010. A Global Analisis of Protected Area Management Effectiveness. Environmental Management 46, 685- 698.

Lockwood, M., Davidson, J., Curtis, A. Stradford, E.and Griffith, R., 2009 . Governance principles for natural resources management. Society and Natural Resources.

Lockwood, M., 2010. Good governance for terrestrial protected areas: A framework,

principles and performance outcomes. Journal of environmental management 91: 754-766.

Mansourian, S and Oviedo, G., 2009. Framework on Governance on Protected Areas and Livelihoods. IUCN, Ukaid.

Moore, S. A. 2005. Regional delivery of natural resource management in Australia: Is it

democratic and does it matter? In Participation and governance in regional development, eds. R. Eversole and J. Martin, 121–136. Aldershot, UK: Ashgate.

Newman, J., Barnes, M, Sullivan, H. and Knops, A., 2004. Public Participation and

Collaborative Governance. Journal of Social Policy 33, 203-223.

North,D.C., 1990. Institutions, Institutional Change and Economic Performance, New York, Cambridge University Press.

Oakerson, R.J. and Parks, R.B. , 2011. The Study of Local Public Economies: Multiorganizational, Multi-level Institutional Analysis and Development. The Policy Studies Journal nº 39-V 1.

Ogra, M and Badola, .R.,2008. Compensating Human–Wildlife Conflict in Protected Area Communities: Ground-Level Perspectives from Uttarakhand, India. Human Ecology 36,717- 729.

Ostrom, E.,1990. Governing the commons: The evolution of institutions for collective

action, Cambridge, Cambridge University Press.

Ostrom, E.; Burguer, J.; Field, C.B.; Norgaard, R.B. and Policansky, D. ,1999. Revisiting the commons: Local Lessons, Global Changes. Science 284, 278-282.

Ostrom, E., 2000. Collective Action and the Evolution of Social Norms. Journal of

Economic Perspectives 4, 137-158.

Ostrom, E. , 2009. A general Framework for Analyzing Sustainability of Social-Ecological Systems. Science 325, 419-422.

Ostrom, E., 2010. Polycentric systems for coping with collective action and global

environmental change. Global Environmental Change 20, 550-557.

Paavola, J., 2005. Environmental justice and governance: theory and lessons from the

implementation of the European union‘s habitats directive. CSERGE Working Paper EDM 03-05.

Perez-Cirera, V. and Lovett, J.C.,2006. Power distribution, the external environment and common property forest governance: A local user groups model. Ecological Economics 59, 341-352.

Schultz, L. and Duit, A., 2010. Participation, Adaptive Co-management, and Management Performance in the World Network of Biosphere Reserves. World Development 39, 662- 671.

Schwab, K., 2011. The global competitiveness report 2011-2012. World Economic Forum.

Shahabuddin, G. and Rao, M., 2010. Do community-conserved areas effectively conserve biological diversity? Global insights and the Indian context. Biological Conservation 143, 2926-2936.

Smith, R. J., Muir, R.D.J., Walpole, M.J., Balmford, A. and Leader-Williams, N., 2003. Governance and the loss of biodiversity. Nature 426, 67–70.

Soutullo, A., de Castro, M. and Urios, V., 2008. Linking political and scientifically derived targets for global biodiversity conservation: implications for the expansion of the global network of protected areas. Diversity and Distributions 14, 604-613.

Stoll-Kleemann, S.; Bender, S.; Berghofer,A.; Bertzky,M.; Fritz-Vietta,N.; Schliep,R. and Thierfelder,B.,2006. Linking governance and management perspectives with conservation

Thyl de Lopez, T., 2003. Economics and stakeholders of Ream National Park, Cambodia. Ecological Economics 46, 269-282.

Tarschys, D. 2001. Wealth, Values, Institutions: Trends in Government and Governance.In OECD, Governance in the 21st Century.Pg. 27 Organisation for Economic Co-operation and Development, Paris.

Transparency Internacional, 2011. Corruption Perception Index 2011.

UNDP, 1997. Governance for sustainable human development. A UNDP policy document.

UNDP ,2011. The Millennium Development Goals Report.

Udo, V.E. and Jansson, P.M., 2009. Bridging the gaps for global sustainable development: A quantitative analysis. Journal of Environmental Management 90, 3700-3707.

Vollan, B and Ostrom, E., 2010. Cooperation and the Commons. Science 330, 923.

SECCIÓN III. LA GESTIÓN DE LAS ÁREAS PROTEGIDAS DESDE EL BUEN GOBIERNO. CAPÍTULO 3

Amazonía (Colombia). Foto: V. Urios.

A CRITICAL REVIEW OF MULTI-CRITERIA DECISION MAKING IN PROTECTED AREAS.

Mónica de Castro* and Vicente Urios

CIBIO- Estación Biológica Terra Natura, Universidad de Alicante, Campus San Vicente del Raspeig s/n, Edificio Ciencias III, 03080 Alicante, Spain

ABSTRACT

Multi-criteria analysis in colaborative decision making can provides a useful tool to implement a good governance in protected areas, where there are strongs conflicts of interest between stakeholders. This paper offers an in-depth review and an analysis about multi-criteria decision making methods in protected areas. The analysis has been considered through the topics "Design of Protected Areas", "Land Use" and "Management" and "Species" and it is based in two dimensions: methods and participation. Topics and Participation were significantly related and constrasted using a Chi-squared test. We have identified two groups by topics: the problems about Design of Protected Areas and Species use continuous methods and they not include the stakeholders preferences. On the other hand problems about Land Use and Management use discretes methods where the participation is increasing. The impulse of participatory techniques with multi-criteria analysis promotes decision making process adapted to stakeholders, using easily understandable techniques and dealing uncertainty due to imprecision of the individual preferences. Finally, we add ecologic value and vulnerability with a specific analysis about Biodiversity Hotspots Regions.

Key words:

Multi-criteria Analysis, Protected Areas, Colaborative Decision Making, Biodiversity Hotspots

1. INTRODUCTION

Multi-Criteria Decision Analysis (MCA) is "an umbrela term to describe a collection of formal approaches wich seek to take explicit account of multiple criteria in helping individual or groups explore decisions that matter" (Belton and Stewart,2002).

The use of Multi-Criteria Decision Analysis for Decision Making (hereafter MCDM) is particularly useful for resolving conflicts of interest, such as those related to the management of natural resources in protected areas, where economic, ecological and social interests clash with each other (Ananda and Herath., 2009; Hajkovicz, 2007; Marchamalo and Romero, 2007; Marshall et al., 2011). These methods provide a structured framework of discussion that may be helpful in resolving conflicts and optimize resources. Moreover, they bring transparency to the processes of participation in the formulation of public policy for natural resource management (Ananda, 2007) and are an interesting source of information for managers.

MCA in collaborative decision making can be a useful tool for implementing a good governance. Graham et al. (2003) define good governance in protected areas on the basis of five attributes: legitimacy and voice, direction, performance, accountability and fairness. This principles are based in the United Nations Development Program principles of good governance: Participation, Consensus orientation, Strategic vision, Responsiveness of institutions and processes to stakeholders, Effectiveness and Eficiency, Accountability to the public and to institutional stakeholders, Transparency, Equity and Rule of Law (UNDP, 1994). On one hand, MCA provides a structured framework for decision making. On the other hand, Group Decision Making provides a scenario where is possible to incorporate transparently the participation of stakeholders. The interactivity of the process has more chance of success to achieve the maximum consensus and regain the loss of reciprocity that sometimes is generated in protected areas. Thus, participatory multi-criteria analysis can help to integrate some of these principles of good governance in the management of protected areas.

The concern for a good governance in protected areas has been driven by (i) the huge conflict generated by the use of resources, (ii) the growing role of local communities in the management of natural resources (Alcorn, 2010; Borrini-Feyerabend., F., 2003, Ostrom, 1999) and (iii) the social demand for an institutional framework characterized by globalization, transparency and public participation (Dearden et al., 2003). These three factors have made necessary to incorporate new forms of governance where stakeholder participation plays an important role in the structure of relations and that should be reflected in management actions. The governance and management have to work as an integrated system to achieve social and conservation objectives in protected areas (Nkhata and McCool, 2012; Stoll-Kleeman, S. 2006). Parallel to the interest promoted by the quality of governance (Dearden et al., 2005), an impulse of participatory MCDM has been generated (Ananda and Herath., 2009, Mendoza and

Martins, 2006). However, to date, there is no review on the use of participatory MCDM in protected areas.

To date, there have been several literature reviews on MCDM in natural resource management. Ananda and Herath (2009), Huang et al. (2011) and Kiker et al. (2005) have reviewed the use of MCDM in natural resource management taking into account contaminated sites, a broad review the first two and forest management in the other one.. Moreover, the revisions of Diaz-Balteiro and Romero (2008), Mendoza and Martins (2006) and Proctor and Qureshi (2005) consider participation in their reviews. Only there has been a mini-review on the use of MCDM in protected areas, that does not takes into account participation (Moffett and Sarkar., 2006).

Here, we provide a thorough review of studies on MCDM in protected areas. We reviewed 131 articles on MCDM in protected areas from 2000 to 2012. The literature review is analyzed from two approaches: methods and participation. The first approach analyzes the different MCDM methods according to the problem to solve. The second one analyzes the use of MCDM in colaborative decison making and the type of participation. Both approaches are based on four key issues in protected areas, or Protected Areas Topics (hereafter PAT): Design of Protected Areas, Land Use, Management and Species.

The specific objectives of this work are:

1.To review MCDM models and their application in protected areas in the last decade.

2. To identify the major multi-criteria techniques in protected areas and the problems they solve.

3. To analyze the evolution of participation to these models.

4. To identify the use of participatory MCDM in priority conservation areas as Biodiversity Hotspots and biogeographic regions.

This paper is organized as follows: the following section gives a brief introduction on the main MCDM methods. Section 3 presents the results of literature review from two approaches, multi-criteria methods and participation. The last section lists the main conclusions of this work.

2. MCDM methods

There are various types of multi-criteria methods. One of the most widely used classification is based on the number of alternatives and distinguishes between Multi-attribute and Multi-objective techniques (Figueiras et al. ¸ 2005 ;Korhonen et al. 1992; Mendoza et al., 2006; Proctor and Qureshi, 2005;). The first ones use discrete values and obtain a ranking of alternatives. They may employ a paired comparison method or functions of value. The Multi-objective techniques are continuous models using optimization techniques such as linear programming and geometric or heuristic optimization techniques to select the best possible alternative. These models are also called "open" models since that they do not establish a priori the number of alternatives. The following part briefly explains the main multi-criteria techniques used in natural resource management.

Discrets Methods

The Analytical Hierarchy Process (AHP) uses a pairwise comparison in order to obtain the relative importance of the criteria and of the alternatives on a hierarchical structure of the decision problem. It uses se value judgments and quantifies the importance of the criteria and objectives to prioritize management alternatives (Saaty,1982).

Analytical Network Process (ANP) is a generalization of AHP, where the base is not hierarchical structure but networks. Priorities are set in the same way as with AHP using pairwise comparisons and value judgments (Figueira et al., 2005).

The Multiattributte Value Theory (MAVT) obtains a function value for each criterion and then these individual functions are aggregated into a global value function (Belton and Stewart., 2002). Its application is more complex than that developed by AHP but also is one of the most widely used techniques in natural resource management.

Preferente Ranking Organisation METHod for Enrichment Evaluations (PROMETHEE): is a multi-criteria outranking technique belonging to the Belgian School and developed by Brans in 1982. It performes pairwise comparisons of the criteria and is based on improvement relationships to prioritize alternatives. PROMETHEE I provides a partial ranking of the alternatives starting from positive and negative flows. PROMETHEE II provides a complete ranking of alternatives using net flows for each alternative (Figueiras et al., 2005). Other variants of PROMETHEE as PROMETHEE III, IV PROMETHEE, PROMETHEE V, VI and PROMETHEE GDSS PROMETHEE offer different options to solve a wider range of problems.

ELimination Et Choix Traduisant la REalité (ELECTRE): is a French outranking technique developed by Roy in 1968. ELECTRE uses the same approach of PROMETHEE to define the ranking of alternatives based on relations of overrating, but uses a concordance and discordance analysis for the desirability of each alternative (Roy and Vincke, 1984). ELECTRE I y II get a qualitative ranking of alternatives, based on quantitative criteria. ELECTRE III also considers quantitative criteria but obtains a quantitative ranking as intervals, defining "pseudo-criteria" (Moffet et al., 2006). The latest variants of ELECTRE are ELECTRE IV, ELECTRE-IS and ELECTRE-TRI. They also use pseudo-criteria and all but ELECTRE IV require information on weights. Some of these methods, such as ELECTRE III and ELECTRE-TRI, are based on fuzzy logic.

The Multi-attribute Utility Theory (MAUT) is based on Expected Utility Theory, which assumes that each criterion is directly associated with a quantitative attribute measured in cardinal scale (Belton and Stewart, 2002). This method is similar to MAVT but incorporating uncertainty, defining utility functions for each criterion and then adding them to a global utility function.

Multi-objective Optimization Methods

Linear programming: includes one objective to be maximized or minimized, with all other objectives expressed as constraints (Myllyviita et al.,2011).

Goal Programming : This method formalizes the "satisficing" concept and requires a measure of "distance" or discrepancy from the target (Ananda and Herath.,2009)

Compromise Programming: It provides nearly optimal solutions without completely guaranteeing either the feasibility or optimality of the results (Myllyviita et al.,2011)

Others:

Fuzzy methods: The fuzzy set logic uses imprecise and uncertain information. This approach specifies each alternative with some degree of membership (Ananda and Herath.,2009)

Soft systems methods: these are methods with a very small (if hardly any) structure, based on group participation. "They give primacy to defining most relevant factors, perspectives and issues that have to be taken into account, and in designing strategies upon wich the problem can be better understood and the decision process better guided" (Mendoza and Martins.,2006) .

2. METHODS

2.1. Literature search

The literature review hs been performed through a search among journals belinging to the Journal Citation Reports (Science and Social Science). Given the multidisciplinary nature of the research, the search was conducted in the following areas: Operations Research/Management Science, Biodiversity Conservation, Economics, Forestry, Environmental Sciences/Ecology, Agricultural Economics and Policy, Business and Statistics/ Probability .

2.2. Classification scheme

2.2.1. Multi-criteria Methods

The multi-criteria techniques have been grouped into eight classes: (i) AHP/ANP (ii) Continuous methods (iii)Fuzzy (iv)Mix (v)Outranking (vi)Soft Systems (vii) Value (viii) Others

2.2.2.Participation

The work has been classified considering the participation and collaboration of stakeholders, based on the model of Belton and Stewart (2002):

1. No Participatory: stakeholders' preferences are not incorporated in any stage of the decision-making process

2. Participatory without Colaborative: the participants individually express their preferences without interacting among each other. Individual surveys or individual interviews are the usual methods to include this type of participation.

3. Colaborative: there is some interaction among participants in the decision making process.

2.2.3. Protected Area Topic (PAT)

This review has focused on problems concerning protected areas, which in some cases incorporate empirical work.

The papers have been grouped in four topics: (i) Design of Protected Areas (ii) Land Use (iii) Management (iv) Species

Design of Protected Areas: Includes problems on zoning and demarcation of protected areas and on the assignment of conservation priorities at the spatial scale.

***Land Use*:** It refers to spatial planning, land/water use plans and, generally, works including issues on the use of resources withing protected areas. Two sub-groups have been identified: *Water*, works carried out in river basins and *Land*, all the others. Although this group shares many features with *Management* and is difficult to define the threshold that distinguishes a topic from another one, the land use is the problem causing the majority of conflicts in protected areas. Because of its importance it has been considered a unique topic for this problem. The fundamental difference between the two groups is that while the models identified in *Management* try to answer the question "How to manage?", the ones grouped in *Land Use* answer the question "How to use?".

***Management*:** It takes into account issues related to the distribution of resources, such as project selection, design of policies and plans for sustainable management of resources. Within this group, three subgroups were identified: Resources, Strategics and Tourism. Resources includes works that solve problems on project prioritization and distribution of economic resources. The works included in Strategics analyze problems related to the design of policies and management plans. Tourism refers to the management of sustainable tourism in protected areas.

Species: It refers to problems on wildlife and flor management, control of alien species, zoning in relation to species distribution and ecosystem vulnerability.

2.2.4. Time periods

Finally, the data have been grouped into three homogeneous intervals lasting four years each one, in order to analyze the evolution of the observations: 2000-2003, 2004-2007 y 2008-2012.

2.2.5. Ecological importance

Papers have been clasified according to their Biogeographic region and Biodiversity Hotspot (Mittermeier et al.,2004).

2.3. Data analysis

Results of the literature review were summarized and a Pearson's Chi-squared was used to test for significant differences. Also the Fisher exact test has been used.

The analyses have been performed with the softwares R-Commander v.2.15.2. and Microsoft Excel 2010.

3. Literature review

3.1. Multi-Criteria Methods

As shown in Figure 1 multi-criteria methods used are continuous methods and methods based on the theory of value with a 26% and a 21% respectively, followed by MIX and AHP/ANP with a 17% and a 14% of reviewed articles.

In the last period fewer works using continuous techniques were reviewed. However, the use of all discrete methods has increased since 2008.

Moreover, the framework of Adaptive Management in response to the biological complexity of ecosystems incorporates the concept of uncertainty in many works on protected area management (Prato, 1999). The methods that treat uncertainty due to randomness, as stochastic models (Prato, 2000,2001,2006) have been displaced in favor of methods that treat uncertainty due to imprecision, and models using fuzzy logic (Carvier et al. 2012, Fuller et al., 2010; Kijazi and Kant, 2011; Leathwick et al, 2010, Liu et al., 2010, Prato, 2009), which increased by 300% in the last period. The increase in the use of models simple and easily understood by stakeholders as AHP and group participation techniques unstructured and based on interaction and iteration, as Soft methods, suggest some MCDM techniques oriented towards a new paradigm of protected areas management, that gives importance to community participation.

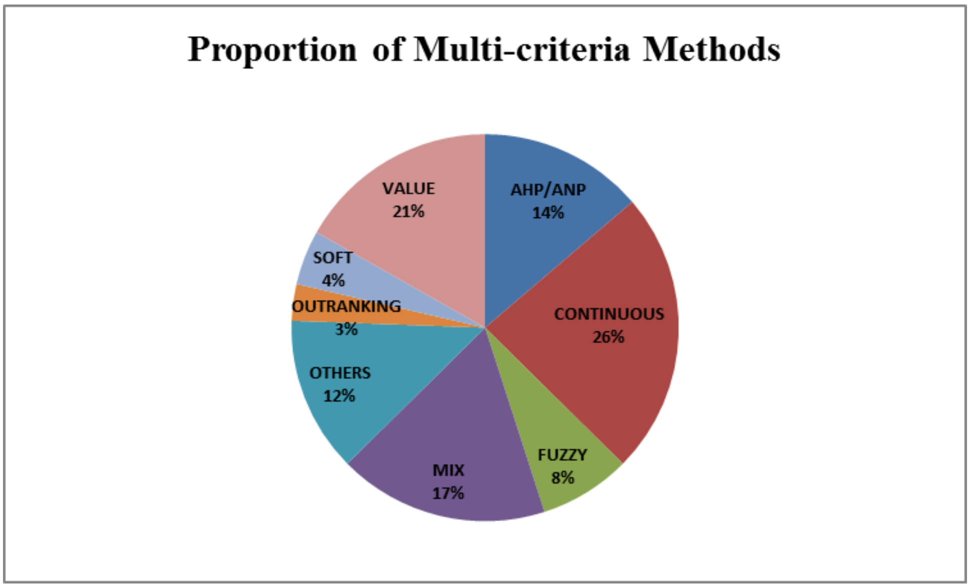


Figure 1. Proportion of multi-criteria methods.

Considering the PAT, clear trends were found in Design of PA and Species. The works on Design of PA use mostly continuous techniques as Integer programming and heuristic models combined with GIS. On the other hand the problems on Land Use and Management use essentially discrete techniques, often combining different techniques in the same model. In the last period some works on Land Use have been revised, that tend to combine GIS technology with participatory techniques. These are explained in more detail in section 3.2.3. Figure 2 shows the multi-criteria techniques in Protected Area Topic.

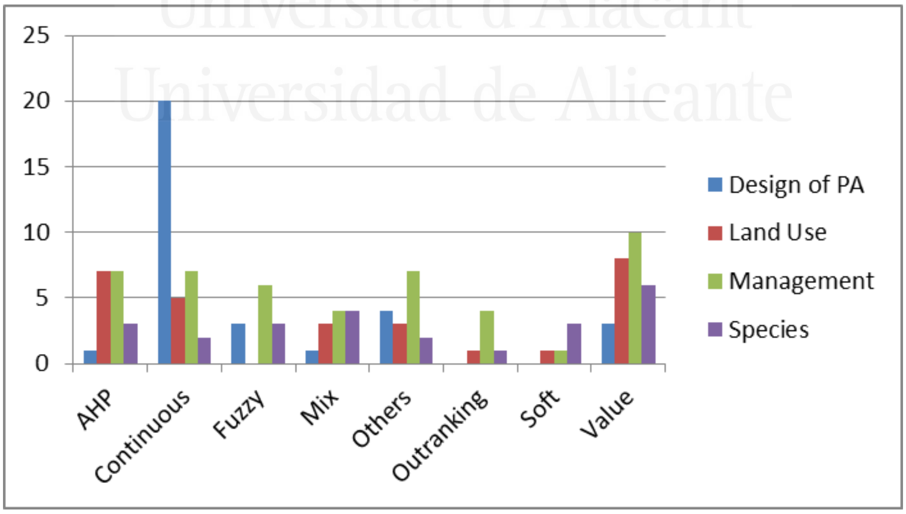


Figure 2. Multi-criteria methods and PAT

Table 1 shows the percentages of articles reviewed by topic. A 36.92% of the articles belong to *Management*, with *Strategics* being the largest subgroup being studied.

% Topics	
Species	**16,41%**
Design PA	**17,95%**
Managment-Strategics **Management-Tourism** **Management-Resources**	23,08% 6,67% 7,18%
Management	**36,92%**
Land Use-Water **Land Use-Soil**	10,77% 17,95%
Land Use	**28,72%**
SUM	100,00%

Table 1. Papers reviewed by topic

Species has been the problem that has increased in relative terms over the last four years. Land Use and Management have also increased in recent years, although less steeply. Protected Area Design increased very strongly between 2004 and 2007, and less in recent years, while Planning and Management has been stable in the last decade, increasing slightly since 2004 (Figure 3).

These data suggest a greater concern for issues caused by anthropogenic use of resources in protected areas. There seems to be a greater concern for the conservation of species and for spatial planning and sustainable resource and the use of existing stocks, at the expense of designing new areas.

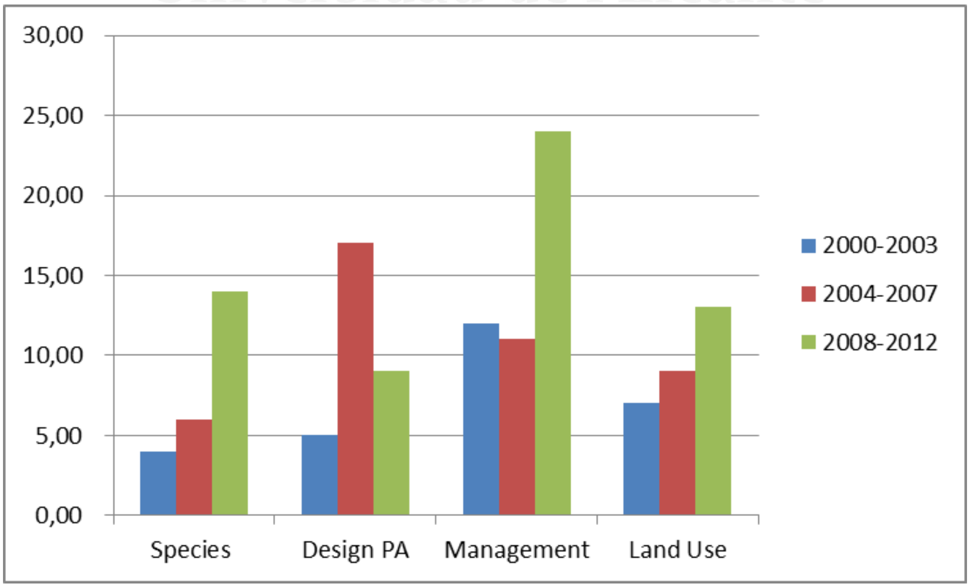


Figure 3. Number of papers by PAT and temporal periods.

3.1.2.Design of Protected Areas

The issues regarding the Planning of Protected Areas also follow a very defined profile; they solve virtually everything through essentially continuous techniques such as Heuristic Models or Integer Programming combined with GIS. The uncertainty is usually incorporated using simulation techniques, although some studies explicitly consider it incorporating stochastic functions as constraints of the objective function. Moilanen et al. (2006) introduced an algorithm that "discounts" the conservation value of a site or species a measurement error associated with statistical predictability.

The most important concern of these works is the adequate representation of different species within spatial units or incorporate the degree of threat, vulnerability and continuity in the models, considering cost constraints. In recent years there has been a significant effort to model the spatial connectivity, which is incorporated into the models through nonlinear functions of great complexity.

3.1.4. Land Use

The most used MCDM techniques are AHP and the techniques based on the theory of value, such as MAVT and MAUT. GIS studies, anyway, use discrete techniques such as AHP and MAVT, unlike works on design of protected areas which employ mainly linear and integer optimization and heuristic models.

Land Use-Land

There is a tendency to use GIS techniques combined with participatory techniques that consider the preferences of the stakeholders. Kazana et al. (2003) is the only study classified in this group that does not consider the preferences of the stakeholders.

Land Use-Water

The application of multi-criteria in water management often cover large areas and includes a large number of stakeholders, as they tend to analyze large rivers. In this review we have selected only those works that include, even partially, a protected area, and where the goal is to resolve issues on the sustainable use of water.

3.1.3.Management

The conservation planning at regional level includes in the management of natural resources organizations with opposite criterias and limited by the resources available for implementation (Zerger et al, 2011). This has created a need to prioritize between different alternatives that optimize resource management but that also consider the preferences of the stakeholders. Papers dealing with this issue in protected areas have analyzed problems on Resources, Strategics and Tourism.

Strategics

In this group only one pper using continuous techniques has been reviewed. Bertomeu and Romero (2001) propose a model to maximize biodiversity considering "the edge effect" in forest management plans, using Goal Programming.

In this subgroup studies that have applied discrete techniques are by far the most abundant ones. Tzionas et al. (2004) design a Decision Support System based on Fuzzy Logic to evaluate restoration strategies of a lake in Greece. Other works like Prato (2009), Kijazi and Kant (2011) and Oikonomou et al. (2011) also use Fuzzy Techniques for solving various problems on strategic management.

Other works incorporate uncertainty through stochastic models. Prato (2000) incorporates uncertainty in a stochastic model to identify the most efficient management plan at the landscape scale and determines its efficiency maximizing expected utility function obtained, additive and risk neutral. Difference between publicly owned landscapes, whose objective is the management of ecosystems and landscapes of private property, with the goal of economic efficiency. Prato, 2001 reuses the Expected Utility approach in a specific study for National Parks, where proposes a model for designing the carrying capacity in the framework of Adaptive Management. All these works, aprt Kijazi and Kant (2011) and Oikonomou et al. (2011) are theoretical models that do not include empirical validations.

Some studies have focused on solving problems on wetland management. Pavlikakis and Tsihrintzis (2003) compares three MCDM techniques from the Ecosystem Management approach: MAUT, Compromise Programming and AHP to integrate stakeholders' preferences on four alternative management wys of a Greek National Park included in the Ramsar category. Herath (2004) and Hajkowicz (2008) also include the preferences of local communities in the management of wetlands in Australia using different MCDM techniques very easy to apply. In the first case with AHP and in the second one with Direct Rating.

Some studies concerning the identification of indicators for natural resource management in protected areas have been reviewed, too: Mendoza and Prabhu (2000) define indicators of sustainable forest management in a forest in Malaysia using participatory techniques such as the Delphi method and Nominal Group Technique. for integrate the views of experts and stakeholders. These authors compared three multi-criteria methods: Ranking method, Rating and AHP method. Tran et al. (2002, 2004) used ANP and Principal Component Analysis to identify indicators for the environmental assessment of ecosystems, validating the model in river basins in the Mid-Atlantic Region (USA). Wolfshlener and Vacik (2008.2011) also used the ANP to define indicators of sustainable forest management under "pressure-state-response" and use them to evaluate four management strategies

Tourism

The paper that we nalyzed onoutdoor activities and tourism within protected areas solve a variety of problems. Rudolphi and Haider (2003) is the only revised paper that uses ELECTRE, specifically a hybrid between ELECTRE and AHP, and applies it to define management plans visitors in a National Park of Canada and the conservation of ecological integrity. Garcia-Melon et al. (2010) used ANP to prioritize sustainable tourism management strategies in a national park in Venezuela incorporating the opinions of expert and stakeholders. Lawson and Manning (2003) incorporate the preferences of visitors to a National Park in Alaska to design wildlife management plans. Arabatzis and Grigoroudis (2010) evaluated the satisfaction of tourists in a national park in Greece using specific software for this purpose, MUSA-Multi-criteria Satisfaction analisis, based on MAVT. Semeniuk et al. (2009) also analyze the tourist preferences regarding different management strategies of a marine protected area, the Cayman Islands. The most common form of participation are individual surveys.

Resources

The majority of the papers included in this subgroup used mainly multi-criteria techniques based on the Expected Utility Theory (MAUT). Davis et al. (2006) develop a theoretical framework for selecting conservation investments that deal with different priorities of biodiversity conservation, considering the quality of the resources, the threat to the quality of resources and the costs, in the Sierra Nevada ecoregion (California). Kurttila et al. (2006) calculated the subsidy that compensates for the loss of utility derived from the conservation of biodiversity on private land in Finland, first defining the utility functions and the maximising them through heuristic optimization techniques. Hajkowicz (2007, 2009) uses MAUT and Compromise Programming to distribute financial resources for environmental conservation in Australia.

Other studies used multi-criteria analysis for the allocation of economic resources. Schmoldt and Peterson (2001) used AHP to prioritize eight projects in a National Park according to their management objectives, and based on three different scenarios. Hajkowicz and Collins (2009) employ Compromise Programming for the distribution of financial resources to conservation plans in Australia

3.1.4. Species

The 63.6% of the work relating to one or more species use GIS technology. Young et al. (2012) mad a risk assesment for a rare plant, *Panax quinquefolius* L. (American Ginseng) in a National Park in Virginia, USA, identifying potential areas of abundance to strengthen protection regulations. Pasqualini et al. (2011) evaluated different management options for the pine *Pinus pinaster* in Corsica, considering the fire risk and

Arianoutsou et al. (2011) evaluated the resilience of Aleppo pine forest after a fire in a Greek National Park: Cape Sounion national Park. These studies comibine multi-criteria techniques with GIS.

Other studies use species-specific habitat requirements solve problems on zoning in protected areas. Rayfield et al. (2009) used the requirements of the American Marten *Martes americana* and of two of its preys to zone a protected area in Canada. Store and Kangas (2001), Kurttila et al. (2002) and Reynolds (2001) also analyzed habitat requirements for a slow-growing tree species *Skeletocutis odora*, two mammals (*Pteromys volans* y *Alces alces*) and the salmon, respectively. The former two use a heuristic optimization technique HERO, combined with AHP and GIS. The latter uses AHP for weighting and SMART for the ranking of alternatives.

Some works focus on the conservation of forest species in Europe. Dhar et al. (2008), prioritize six conservation strategies of a species of yew *Taxus L. Bacata* in Austria, using AHP to evaluate them. Romero-Calcerrada and Luque (2006) used an indicator species (*Picoides trydactilus*)for assessing the biodiversity of a forest of Finland, obtaining functions and habitat suitability maps of this species.

Also the problems on habitat vulnerability may be analyzed with spatial data, but at a landscape scale. These problems are usually solved using multi-purpose programming combined with GIS, similarly to the problem analysis on the design of protected areas. Fuller et al. (2010) assess the threats to biodiversity from three areas in Malaysia including both protected and unprotected areas. They use a GIS database to evaluate and incorporate biodiversity threats with Fuzzy functions. Vimal et al. (2012) used the presence-absence of important species, large areas of high ecological and landscape diversity to identify spatial patterns of ecological vulnerability.

3.2. Participation

The protected area topics that incorporate a higher percentage of studies with participation are Land Use with 20.6% followed by Management with 19.1%. We found a strong dependence between participation and PAT ($p < 0.001$ Chi-square). These results suggest a strong tendency to incorporate stakeholders' preferences for solving problems related to land use and management issues for protected areas and to not include them in the other topics. This may be due to the fact that issues associated with the use of resources are the ones that generate most of the conflicts.

Figure 5 shows the percentage of participation which hve been included in each topic. The highest percentage of participation is the topic Land Use, with 20.6%, followed by 19% in Management. The highest percentage of non-participation is Design PA, with a 22% of the sample.

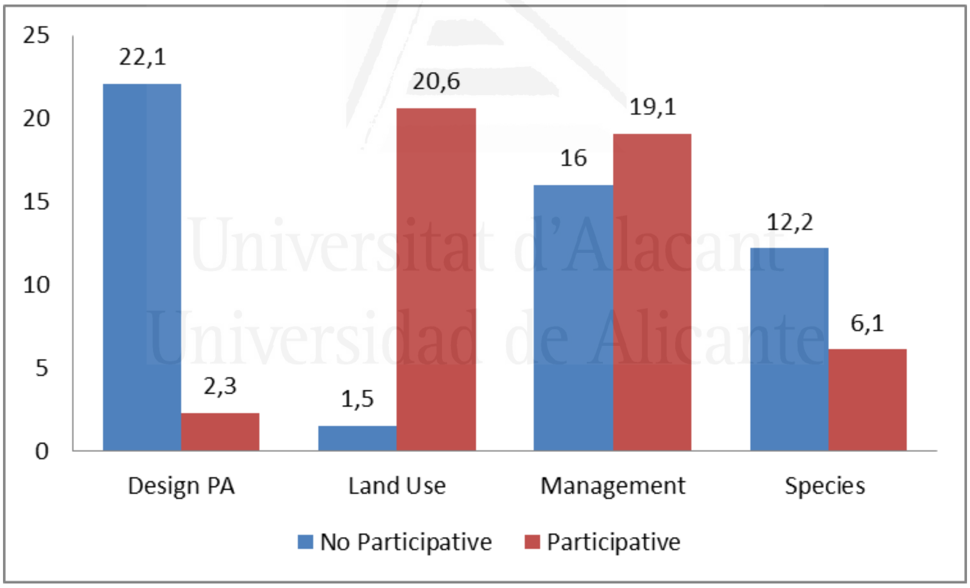


Figure 4. Participation by PAT

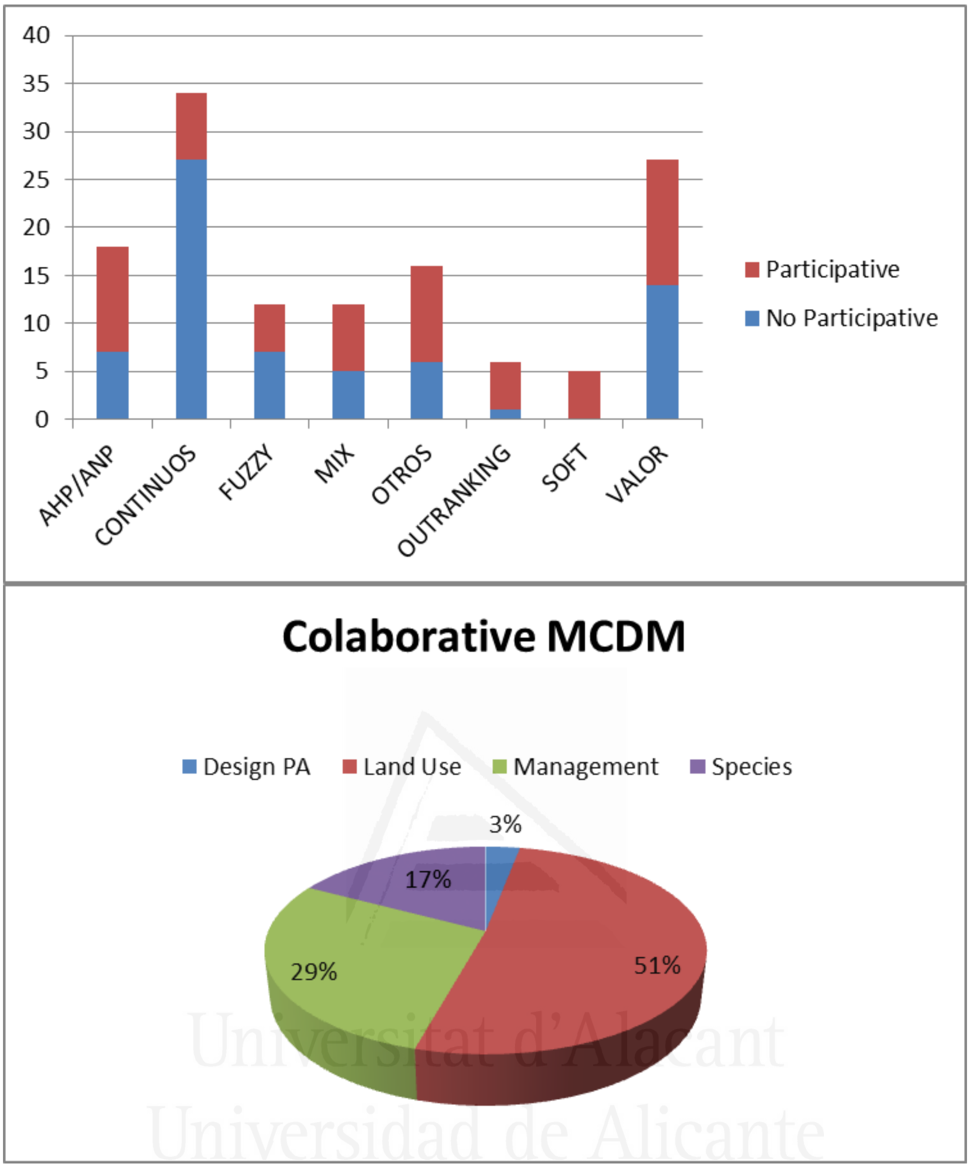


Figure 5(a). Percentage of collaborative MCDM by PAT (b) Participation by MCDM methods.

Figure 6a shows the evolution of the prticipation in the considered period according to the Protected Areas Topics. It identifies a very significant increase in participation since 2008, considering all topics. This is due to the proliferation of participatory work in Species since 2008, especially regarding control of alien species. However, as shown in Figure 6b, while participation without collaboration implies a greater percentage in the first two periods, the collaboration has grown larger since 2004, surpassing participation without collaboration.

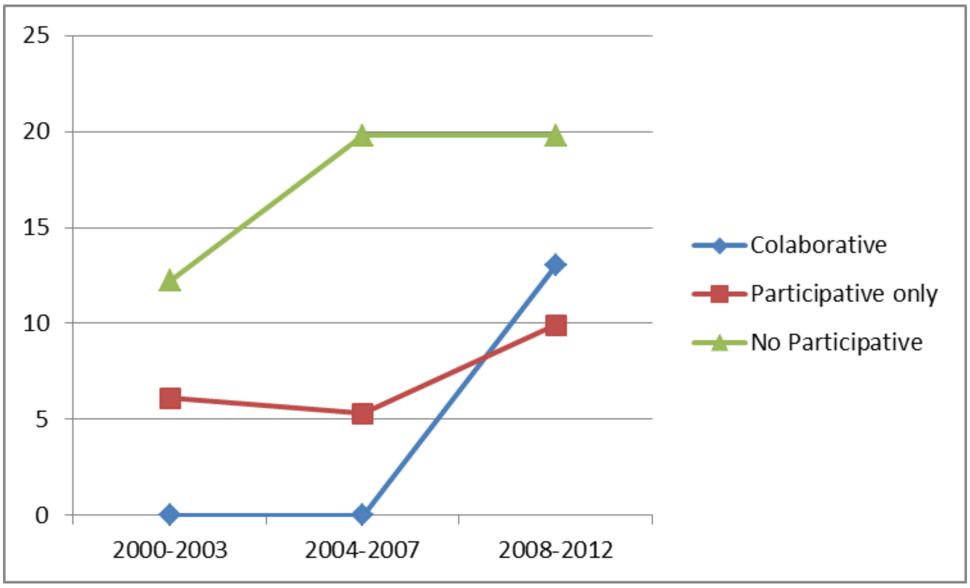


Figure 6. Evolution of Participation type.

This increase in the collaborative processes is largely due to the development in recent years of innovative MCA techniques in colaborative decision making, as the Deliberative Multi-Criteria Evaluation (DMCE) and Decision Analysis Interview (DAI). The pioneering work in using this type of methodology was carried out in Australia. Proctor and Dreschler (2003) use a DMCE to identify appropriate options for recreation in a vast area of 2.4 million ha, which includes several protected areas with different degrees of protection. The process employs a software with interactive support among participants and a Citizens Jury. Marttunen and Hamalainen (2008) use another participatory technique a high degree of collaboration, the Decision Analysis Interview (DAI), using multi-criteria analysis. This paper develops a process of collaborative decision making to design a regulatory policy of a large watercourse. The main findings indicate the importance of special care in planning, design and preparation of the process and emphasizes the importance of interactivity to ensure data consistency. On the other hand, interactivity and iterativity generate transparency in the process and stakeholders' confidence.

Zendehdel et al. (2010), in Iran, introduced a priori the collaboration in a deliberative process, using an intensity index (Social Rank Order of Alternative Impacts (SROAI)) that is maintained throughout the process. The aim is to ensure the consistency of the group's decision and transparency. In addition, minority groups see their preferences represented in decision-making and all stakeholders adopt a greater willingness to reach agreements.

Decision-making processes with a high degree of collaboration are very laborious and costly in time and resources, but it seems clear that the degree of collaboration influences the success to reach consensus. The challenge is to find a balance between the degree of collaborative participation and the operational ability of the model, that considers the preferences of the stakeholders, bening transparent and providing acceptable solutions with the highest consensus. Finally, the method has to provide especially an open space for dialogue and shared information allowing all the groups linked to the protected area to express their priorities and that they can be quantified and considered in decisions affecting their interests.

Table 1 shows the studies reviewed that use multi-criteria analysis with participatory methods, by author and year of publication, MCDM method, PAT and Studie Case.

3.2.1. Design of Protected Areas

The 90.63% of the revised articles on Protected Areas Design exclude participatory techniques, therefore only two of them consider the preferences of the stakeholders. Saharifi et al. (2002) use collaborative techniques to integrate the preferences of local actors from the problem statement until the identification of the boundaries of the National Park Tunari in Bolivia, in relation to the problem of illegal settlements in the park boundaries. Bojorquez-Tapia et al. (2004) choose AHP and MAVT to design a National Park in Mexico, integrating stakeholders' preferences collaboratively to define the boundaries and zoning the Sierra San Pedro Martir National Park. This work is based on the approach "Land Suitability Assessment" (LSA), which considers the interests of stakeholders in defining the appropriate use of the land. These two analyses use GIS.

Table 2 show papers inclused in Design with participation by MCDM method, case description and participation type.

Authors	MCDM Method	Case Description	Participation Type
Sharifi et al.,2002	Multi-objective Programming-AHP-GIS	Location of sustainable boundary between a protected area and a city to solve a problem about illegal settlements	Participation
Bojórquez-Tapia et al.,2004	AHP-MAVT-GIS	Land suitability assessment approach for delimitation and zoning of protected areas	Colaboration
Hajehforooshnia et al.,2011	Fuzzy-AHP-MOLA method-GIS	Protected area zoning	Participation

Table 2. Papers inclused in Design with participation by MCDM method, case description and participation type.

3.2.2. Land Use

The use of resources is the issue that generates more conflicts in protected areas. This may be one of the reasons for which the use of participatory and collaborative techniques experienced such a big increase. The 93.1% of articles reviewed in this group include participatory techniques and the 62.1% include collaboration. This result reflects the need for solutions close to consensus that minimize conflicts of stakeholders on the use of natural resources.

Most works that incorporate participatory techniques developed in Northern European countries. Ananda (2007) and Ananda and Herath (2008) incorporate stakeholders' preferences to define the land use in Finnish forests using AHP and MAVT. Hiltunen et al. (2009) employ an interactive software that uses heuristics models (MESTA) to support decision-making on sustainable forest management in Finland.

In the last years there has been a tendency to use participatory techniques combined with GIS. Fitzimons et al. (2012) and Arciniegas et al (2011) incorporate the preferences of the agents over spatial definitions of predefined criteria, in most cases with satellite data and expert opinion. Strager and Rosenberg (2006) also discussed the same problem in the Cacapon River watershed, Virginia, but identifying the preferences before defining the maps with GIS. They analyse separately the preferences of "nonlocal" experts and of local stakeholders, finding significant differences. This shows a gap in the potential education and information, which should be corrected through a complete information of the experts to the to stakeholders on the importance of the various criteria of land uses.

Nordstrom et al. (2010) use GIS and MAVT to prioritize the use of a natural park in Sweden, but incorporate stakeholders' preferences to define the criteria and alternatives, from the early stages of the decision problem.

Arciniegas et al. (2011) also use interactive GIS maps. The novelty is the use of visualization techniques (Table Touch) as a support tool for discussion in a decision-making process on land use zoning in the Netherlands. However, these maps are designed based on expert judgment and stakeholder preferences are incorporated later.

GIS has also been used in combination with collaborative techniques. Duke and Aull-Hyde (2002), Pierce et al. (2005) and Mustajoki et al. (2011) incorporate deliberative techniques in decision-making processes on land use. The first one considering the preferences of the general population and the other two considering stakeholders' preferences and using deliberative techniques to elicit their preferences.

These studies suggest a high heterogeneity in the employed techniques and also in the way to incorporate stakeholders' preferences into the decision making process.

The work related to water use are characterized by a high degree of participation and collaboration. The only work that does not include these techniques is Yilmaz and Harmancioglu (2010). They use Compromise Programming and TOPSIS to analyze a problem on water management in a river in Turkey. The other works include some form of participatory techinique. Cauwenbergh et al. (2008) used simulation techniques and indicators and participatory techniques through individual surveys to implement a model for aid to decision-making on water use in the Rio Andarax, that includes a part of the Sierra Nevada National Park, Spain.

The other reviewed papers use collaborative techniques such as Decision Analysis Interviews (DAI) and Deliberative Multi-Criteria Evaluation (DMCE). Hamalainen et al. (2001), Mustajoki et al., (2003) and Marttunen and Hamalainen (2008) analyze the problem of regulation of Lake Paijannen-Finland with HIPRE-web, an interactive software to aid decision making using visualization techniques and whose main idea is to represent group preferences in a clustered way and then seek consensus from this joint representation of the problem. The first two perform two experiments with two groups of students in a version that obtains Pareto-optimal solutions. Mustajoki et al. (2003) are based on MAVT and use AHP to obtain the weights of the criteria nd use DAI method. Marttunen and Hamalainen (2008) also use DAI.

Lennox et al. (2011) use DMCE methods to integrate the stakeholders' preferences in the context of water in New Zealand, including the development of specific criteria for Maori interests in order that no stakeholder is left out in the process decision making.

Hajehforooshnia et al. (2011) use a multi-criteria evaluation MOLA (Multi-objective land allocation) for zoning Ghamishloo Wildlife Sanctuary (Irán) considering nine major criteria: wildlife hábitat, vegetation cover, soil, distance to historical places, wáter resources, road, scenic beauties in the landscape, and also to residential areas, and to the core zone werw considered. This three papers use GIS.

Table 3 show papers inclused in Land Use with participation by MCDM method, case description and participation type.

Authors	MCDM Method	Case Description	Participation Type
Gregory and Wellman,2001	MAUT	Evaluation of restore functioning actions of a National Stuary	Colaborative
Hamalainen et al.,2001	Goal Programming	Evaluation of management policy for a regulated lake-river system	Colaborative
Duke and Aull-Hyde,2002	AHP	Compare the public's sources of value for the environmental, agricultural, growth control and open space attributes for preserved land	Participative
Ananda and Herath,2003a	MAVT	Modelling stakeholders values to ecologically sustainable forest management	Participative
Ananda and Herath,2003b	AHP	Modelling stakeholders values to ecologically sustainable forest management	Participative
Mustajoki et al.,2003	MAVT-AHP	Use of Decision Support System to the evaluation of regulation policies for a lake	Colaborative
Herath,2004	AHP	Evaluation of management planning in wetlands	Participative
Mustajoki et al.,2004	MAVT-AHP	Design of publics policies to lake regulation	Colaborative
Pierce et al.,2005	Analysis GAP-GIS	Evaluation of diferents land use management considering some biodiversity features	Colaborative
Sheppard and Meitner,2005	Scenaries	Analysis of forest management scenarios while integrating public priorities	Colaborative
Vantanen and Marttunen, 2005	Multi-objective Programming	Incorporate public preferences in regulation of a lake	Colaborative
Strager and Rosenberg,2006	AHP-GIS	Identify high priority areas for land conservation	Colaborative
Ananda,2007	AHP	Regional planning of sustainable forest management	Participative
Prato,2007	MAUT-Maxi Min	Priorization of land use policies considering social and economics benefits and environmental costs	Colaborative
Marchamalo and Romero,2007	Goal Programming-AHP	Planning land use in a river	Participative
Ananda and Herath,2008	AHP	Incorporate stakeholder preferences in determining optimal forest land-use choices	Participative
Cauwenbergh et al.,2008	Multi-objective Programming	Water management in a river based in water allocation considering public participation	Participative
Marttunen and Hamalainen,2008	MAVT	Define ecologically,socially and economically sustainable water course regulation policy of a larege regulated water course	Colaborative
Prato,2008	Probabilistics-Fuzzy-AHP-TOPSIS	Rank land use policies for stakeholders having different preferences about buyer satisfaction with the density of residential housing and the percent of the area of interest with high realized habitat for multiple species	Colaborative
Hiltunen et al.,2009	Multi-objective Programming	Define the land use allocation and the corresponding forest management operations for stage-owned forests within these planning regions	Colaborative
Nordstrom et al.,2010	Compromise Programming-AHP-GIS	Planning and zonification based in land uses for a urban forest	Colaborative
Martin-Ortega and Berbel,2010	AHP modified-DEXI program	Explore non-market monetary values of water quality changes	Participative

Authors	MCDM methods	Case study	Participation Type
Silva et al.,2010	PROMETHEE II	Environmental recuperation of a watershed	Colaborative
Arciniegas et al.,2011	MAVT	Land use allocation in land use planning process of a polder	Colaborative
Lennox et al.,2011	Soft Deliberative	Sustainable management of freshwater resources	Colaborative
Mustajoki et al.,2011	MAVT	Identify adverse impacts of forestry on old forests wich are important grazing areas for reindeer and wich are regarded as intact nature and wilderness areas	Colaborative
Fitzimons et al.,2012	Scenarios-GIS	Evaluation of land use planning in greenbeltsbased on intrinsic characteristics and stakeholders values	Colaborative

Table 3. Papers inclused in Land Use with participation by MCDM method, case description and participation type.

3.2.3. Management

Most of the models that consider the preferences of stakeholders are included in Tourism and Strategics. This may be due to two reasons: on one hand, tourism is a major source of short-term resources in protected areas and, secondly, the management of resources associated with the use of land is one of the largest problem generating conflict, exacerbated in protected areas by restrictions arising from formal protection.

Participation is included in the 54.3% of the papers included in Management, with the 21.7% belonging to collaborative techniques. They have been used in theoreticl models concerning design and evaluation of macro-policies in recent years. Zia et al. (2011) analyze the trade-offs between different management scenarios at different work levels (local, national and international) in a National Park in Tanzania. Oikonomou et al. (2011) also compare different scales in the social assessment with stakeholders and integrates the evaluation of ecosystem services in an area of the Natura 2000 network in Greece. Another example is the evaluation of the social acceptability of three management plans in a national park on Mount Kilimanjaro developed by Kijazi and Kant (2011).

Also Hjorsto(2004), Sheppard and Meitner(2005), Brown and Reed(2009), Zendehdel et al.(2010) y Zia et al.(2011) use participatory techniques. These studies use various techinques such as Softs Systems, visualization and outranking techniques.

Table 4 show papers inclused in Management with participation by MCDM method, case description and participation type.

Authors	MCDM Method	Case Description	Participation Type
Mendoza and Prabhu,2000	AHP	Assessing of criteria and indicators adapted for a particular forest management unit.	Participation
Lawson and Manning,2003	Stated choice analysis	Select wilderness management alternatives considering visitors preferences	Participation
Pavlikakis and Tshrintzis,2003	MAUT-Compromise Programming-AHP	Select management alternatives considering public preferences	Colaboration
Prato,2003	ELECTRE	Select management alternatives in a watershed	Colaboration
Proctor and Dreschler,2003	Deliberative methods-PROMETHEE	Zonification for recreation in based to Ecosystem, Socials, Cultural and Economics Services	Colaboration
Thyl de Lopez,2003	Cost-benefit analysis	Assess how the establishment or destruction of the Park distributes benefits and costs among different stakeholders	Participation
Hjorsto,2004	Soft OR	Priorization of strategic option development and analysis in tactical forest planning	Colaboration
Masozera et al.,2006	SWOT-AHP	Assess the perception of stakeholders towards the suitability of community-based management	Participation
Mrosek et al.,2006	Hierarchical Rating Method	The overall sustainability assessment applying criteria and indicators for sustainable forest management	Participation
Furstenau et al.,2007	MAUT	Evaluation of management planning with climatics scenaries considering stakeholders preferences	Participation
Hajkowicz,2008	Weighted summation	Priorization of environmental problems in wetlands	Participation
Brown and Reed,2009	Parametrics and no parametrics analysis	Colect publics georeferenciated value about three national parks	Participation
Hajkowicz,2009	Compromise Programming	Allocation of financial resources amongst multiple user groups in environmental management problems.	Participation
Hajkowicz and Collins,2009	Compromise Programming	Define an index of sustainability considering investor preferences over multiple services	Participation
Arabatzis and Grigoroudis,2010	LOGIT-Factorial Multinomial	Identify visitors satisfaction in a natural park	Participation
García-Melón et al.,2010	ANP	Evaluation of strategies of sustainable tourisme	Participation
Zendehdel et al.,2010	ARGUS-Outranking	Management to rangeland conservation incorporating social intensities	Colaboration
Kijazi and Kant,2011	Fuzzy	Evaluation of social acceptability of three alternatives forest management regimes	Participation
Oikonomou et al.,2011	Fuzzy	Identifiyng scenaries based in ecosystem services by social actors	Participation
Whitfield et al.,2011	Deliberative methods	Identifiyng a deliberative approach to assess of drylands environment	Colaboration
Zia et al.,2011	MAVT-Trade off	Identifying preferencies about management in social-ecological systems distinct cross-scale scenarios	Colaboration
Carver et al.,2012	Fuzzy	Mapping wilderness in support of decisión about planning, policy and management in protected landscapes	Participation

Table 4. Papers inclused in Management with participation by MCDM method, case description and participation type.

3.2.4. Species

The 33.33% of the articles reviewed the topic Species include participatory techniques and collaboration represents a 16.67%. These percentages refer to works on alien species control and reflect the need to include the views of stakeholders collaboratively when considering problems with social and economic impact. Cook and Proctor (2007), Liu et al. (2010), Liu et al. (2011), Lange et al. (2012) and Liu et al. (2012b) use deliberative techniques with multi-criteria analysis to solve problems related with alien species management. These studies indicate the importance of including the preferences of local populations to make effective management plans.

Table 5 show papers inclused in Species with participation by MCDM method, case description and participation type.

Authors	MCDM Method	Case Description	Participation Type
Maguire, 2004	MAUT	Invasive species management in ecosystems:the management of feral pigs in Hawaiian ecosystems	Colaboration
Phua and Minowa,2005	Compromise Programming-AHP-GIS	Evaluate forest conservation priority considering a biodiversity index to measure the number of species and their arrangements in a spatial unit	Participation
Cook and Proctor,2007	Softs Systems-Deliberative	Assess the threat of exotic plant pests	Colaboration
Liu et al.,2010	Fuzzy and Deliberative	Estimation of potential impacts and evaluation of participants subjective preferences about invasive species management	Colaboration
Liu et al.,2011	Soft System-Deliberative	Identification of pre-border priority ranking for potential invasive species and selection of policy options for managing a post-border invader	Colaboration
Zerger et al.,2011	AHP-GIS	Identification of regional conservation priorities including farmer land use priorities	Colaboration
Lange et al.,2012	AHP	Selection of technologies for using invasive alien plants as a bio-energy feedstock	Participation
Liu et al.,2012	Soft System-Deliberative	Evaluation of potential responses to invasive non-native species: invasion management of non-native myrtle rust in Australia	Colaboration

Table 5. Papers inclused in Species with participation by MCDM method, case description and participation type.

3.2.5. Participation and Ecologic Value

One of the conclusions drawn from the review of Ananda and Herath (2009) is that much of the works on MCDM in forest management are carried out in Australia, northern Europe and Canada. In this review we have taken as a geographical reference the five biogeographical regions Australasia, Nearctic, Palearctic, Neotropical and Afrotropical. Most of the MCDM analyses inprotected areas is developed in the Australasian, Nearctic and Palearctic regions, in particular Australia, Canada and Northern Europe, showing a significant gap in regions of high ecological value as Afrotropical and Neotropical bioregions.

The studies related with water management have been developed, as expected, in arid regions, such as Mediterranean ones and they generally use techniques with high degree of participation and collaboration. Recently, in the Afrotropical region some theoretical work on Land Use with a high degree of participation have been developed. The works done in the United States and Canada are related to Management and, generally, they do not use participatory techniques.

On the other hand, in Northern Europe the most studied topics are those related to sustainable forest use, while in Australia different types of studies have ben developed, including both sustainable use of resources, as well water management, land use and control of alien species.

Protected area design has been broadly worked in virtually every geographic area.

The multi-criteria analysis to address issues of *Management* in protected areas has been restricted to the U.S. and Canada, Australia and Northern Europe. However, in Mediterranean and tropical ecosystems, with a high degree of vulnerability and ecological value (Soutullo et al., 2008) we found only one paper on multi-criteria analysis in collaborative decision making concerning Management in protected areas. Pavlikakis and Tshrintzis (2003) compare three multi-criteria methods in colaborative decision making to select wetland management alternatives in the River Nestos Delta National Park and in Lakes Uistonida and Ismarida (Greece).

In order to identify reltionships between the attributes "Biodiversity Hotspot" and "Participation" we did a Fisher exact test, that revealed no significant differences ($p = 0.52$), suggesting the independence of these attributes. The 35.1% of the reviewed studies were developed in BH regions and the 18.4% used some form of participation. In this analysis general theoretical models that do not relate to a specific geographic area have not been included.

However, the use of MCDM with participation in Biodiversity Hotspots Regions is mainly due to works on Land-Use-Water, which have been developed mostly in the

Mediterranean region (BH Mediterranean Basin) and South-Eastern Australia (BH-Southwest Australia) and to studies on the control of alien species in South-Eastern Australia.

There seems to be some relationship between BH and PAT (Chi-squared (Fisher) p-value = 0.016). The 62.5% of species conservation works have been performed in BH regions. However, only the 26% of the works on land use, which are those that generate more conflicts, have been conducted in BH regions. The work on BH management represents only the 34%. This suggests that within most of the priority conservation areas there is no concern for raising decisions on management and use of resources in a structured and participatory way.

However, very often local populations conflicts represent a strong threat to the conservation of ecological areas. Participatory MCDM analysis can help to minimize potential conflicts of interest and to achieve social and conservation objectives in particularly vulnerable areas.

Table 6 shows the work done in Biodiversity Hotspots regions by Publication year, Biogeographic Region and Protected Area, Biodiversity Hotspot, Type of Participation and Protected Area Topic.

Authors	Biodiversity Hotspot	Protected Area	PAT	Participation Type	Biogeographic Reams
Mendoza and Prabhu,2000	Sundaland	Kalimantan-Indonesia	Management-Strategics	Participation	Indo-Malay
Memtsas, 2003	Mediterranean Basin	Creete	Design of Protected Areas	No Participation	Paleartic
Pavlikakis and Tshrintzis,2003	Mediterranean Basin	National Park of River Nestos Delta and Lakes Uistonida and Ismarida	Management-Strategics	Colaboration	Paleartic
Thyl de Lopez,2003	Indo-Burma	Ream National Park-Cambodia	Management-Strategics	Participation	Indo-Malay
Bojórquez-Tapia et al,2004	California Floristic Province	Región Mediterránea Norteamericana (México)	Design of Protected Areas	Colaboration	Neotropic
Costello and Polasky,2004	California Floristic Province	SO California	Design of Protected Areas	No Participation	Neartic
Huth et al.,2004	Sundaland	Deramakot-Malasya	Species	No Participation	Indo-Malay
Maguire, 2004	Polynesia-Micronesia	Hawaii	Conservación de Especies	Colaboration	Neartic
Tzionas et al.,2004	Mediterranean Basin	Lake Koronia	Planificación y Gestión-Gestión Estratégica	No Participation	Paleartic
Huth et al.,2005	Sundaland	Sabah-Malaysia	Species	No Participation	Indo-Malay
Phua and Minowa,2005	Sundaland	Kinalabu Area-Malaysia	Species	Participation	Indo-Malay
Bello-Pineda et al.,2006	Mesoamerica	Marinas-Alacranes Reef National Park-Mexico	Design of Protected Areas	No Participation	Neotropic
Davis et al.,2006	California Floristic Province	Sierra Nevada bioregion-California	Management-Resources	No Participation	Neartic
Cook and Proctor,2007	Southwest Australia	Australia	Species	Colaboration	Australasia
Marchamalo and Romero,2007	Mesoamerica	Costa Rica- The River Birrís	Land Use-Land	Participation	Neotropic
Cauwenbergh et al.,2008	Mediterranean Basin	Andarax-Sierra Nevada National Park	Land Use-Water	Participation	Paleartic
Geneletti and Duren,2008	Mediterranean Basin	Paneveggio-Pale di S. martino Natural Park	Design of Protected Areas	No Participation	Paleartic
Zucca et al.,2008	Mediterranean Basin	Bergamo Province-Italy	Design of Protected Areas	No Participation	Paleartic
Graziano et al.,2009	Mediterranean Basin	Italian Alps	Species	No Participation	Paleartic
Semeniuk et al.,2009	Caribbean Islands	Stingray City Sandbar-Cayman Islands	Management-Tourism	No Participation	Neotropic
Arabatzis and Grigoroudis,2010	Mediterranean basin	Dadia-Lefkimi-Souflion National Park	Management-Tourism	Participation	Paleartic
Martin-Ortega and Berbel,2010	Mediterranean Basin	Sierra Morena and Doñana National Park	Land Use-Water	Participation	Paleartic
Fuller et al,2010	Sundaland	Sundaland biogeographic province Indonesia	Species	No Participation	Indo-Malay
Leathwick et al,2010	New Zealand	Simulacion (un río de New Zealand)	Design of Protected Areas	No Participation	Australasia
Liu et al.,2010	Southwest-Australia	West Australia	Species	Colaboration	Australasia
Orsi and Geneletti,2010	Madrean Pine-Oak Woodlands	Sierra Madre de Chiapas	Species	No Participation	Neotropic
Pecci et al.,2010	Mediterranean Basin	Alpino-Oltrepo-Pavese and Ligurian-Emilian Apennine - Italy	Management-Resources	No Participation	Paleartic
Silva et al,2010	Atlantic Forest	Atlantic forest and mangroves-Jabuatao River Watershed-Brazil	Land Use-Water	Colaboration	Neotropic
Yilmaz and Harmancioglu,2010	Irano-Anatolian	Gediz River Basin-Turkey	Land Use-Water	No Participation	Paleartic

Authors	Biodiversity Hotspot	Protected Area	PAT	Participation Type	Biogeographic Reams
Zendehhdel et al,2010	Irano-Anatolian	Lar rangeland -Iran	Management-Strategics	Colaboration	Afrotropic
Arianoutsou et al,2011	Mediterranean Basin	Cape Sounion National Park-Greece	Species	No Participation	Paleartic
Hajehforooshnia et al,2011	Irano-Anatolian	Ghamishloo National Park	Design of Protected Areas	Participation	Afrotropic
Kijazi and Kant,2011	Eastern Afromontane	East African Montan Forest-Mount Kilimanjaro	Management-Strategics	Participation	Afrotropic
Lennox et al.,2011	New Zealand	Canterbury región-New Zealand	Land Use-Water	Colaboration	Australasia
Liu et al,2011	Southwest-Australia	Australia	Species	Colaboration	Australasia
Oikonomou et al.,2011	Mediterranean Basin	Kalloni-Lesbos-Greece	Management-Strategics	Participation	Paleartic
Pasqualini et al.,2011	Mediterranean Basin	Corsica	Species	No Participation	Paleartic
Zia et al.,2011	Eastern Afromontane	Ruaha National Park-Tanzania	Management-Strategics	Colaboration	Afrotropic
Lange et al,2012	Eastern Afromontane	Agulhas Plain region	Species	Participation	Afrotropic
Liu et al.,2012	Southwest-Australia	Australia	Species	Colaboration	Australasia

Table 6. MCDM papers in Biodiversity Hotspots regions by year, BH, Protected Area, PAT, Participation type and Biogeographic Ream.

3. CONCLUSIONS

The use of multi-criteria techniques in protected areas in recent years has been important mainly to solve problems on "How to managing", rather than "Where to manage." Decision making related with species conservation has been analyzed mostly with multi-criteria techniques, followed by problems on the management and use of land.

We have identified two groups with marked differences in the use of multi-criteria and participatory techniques. Species conservation and protected area design use generally GIS technology and continuous methods, highly structured and highly complex and do not consider the interests of stakeholders. However, the issues that have an economic and social impact such as the problems concerning the control of alien species, incorporate participatory techniques with a high degree of collaboration, little structured and highly iterative. On the other hand, the problems of management and land use employ discrete methods used with an increasig degree of participation.

Integrating participation in multi-criteria analysis seems to be associated with the use of techniques easy to understand and use, requiring no specific knowledge, flexible and that promote interactivity. Furthermore, the concern to integrate the uncertainty due to the imprecision of individual preferences becomes important, with a strong development of Fuzzy Logic based models, in recent years. The need to adapt the processes of decision making not only to the characteristics of the problem to be solved but also to participants seems to be of paramout importance.

The inclusion of GIS technology in virtually all work done in the last decade on the design of protected areas and in recent years on land use is very important. The combination of GIS technology with collaborative decision making becomes very useful in solving problems on land use. These works can serve as a basis for developing participatory models for problem solving in species conservation and in protected area design.

The collaboration has been integrated, mainly through Soft Systems, to solve problems with a major social impact, as the problems of water use, alien species control and some theoretical models on management. The enormous amount of resources and time required does not allow the application to be easy and it seems advisable to find a compromise between the availability of time and resources and the degree of collaboration in the process of decision making.

Finally, it should be stressed the need to develop empirical works on valuable and vulnerable ecosystems. Mediterranean and tropical ecosystems, with a high ecological value and a strong conflict between stakeholders are priority candidates for applying MCDM in colaborative decision making, to aid developing an effective management based in a good governance.

REFERENCES

Abrams, P., Borrini-Feyerabend, G.,Gardner, J. and Heylings, P. 2003. Evaluating Governance. A Handbook to accompany a participatory process for a protected area. PARKS CANADA and TILCEPA—Theme on Indigenous and Local Communities, Equity and Protected Areas of IUCN CEESP /WCPA

Alho, J.M.,Kolehmainen,O.and Leskinen, P.2001. Regression Methods for Pairwise Comparison Data. In The Analytical Hierarchy Process in Natural Resource and Environmental Decision Making. Ed. Kluwer Acdemic Publishers,2001

Ananda, J. and , Herath, G.,2003. Incorporating stakeholder values into regional forest planning: a value function approach. Ecological Economics 45 : 75-90

Ananda, J. and , Herath, G.,2003. The use of Analytic Hierarchy Process to incorporate stakeholder preferences into regional forest planning. Forest Policy and Economics 5 13–26

Ananda, J.,2007. Implementing Participatory Decision Making in Forest Planning Environ Management 39:534-544

Ananda, J. and , Herath, G.,2008. Multi-attribute preference modelling and regional land-use planning. E cological Economics 65: 325-335

Ananda, J. and , Herath, G.,2009. A critical review of multi-criteria decision making methods with special reference to forest management and planning. Ecological Economics 68: 2535–2548

Arabatzis, A and Grigoroudis, E. 2010. Visitor's satisfaction and gap analysis: The case of Dadia-Lefkimi-Souflion National Park. Forest Policy and Economics 12: 163-172

Arciniegas, G., Janssen, R. and Omtzig, N. 2011. Map-based multicriteria analysis to support interactive land use allocation. International Journal of Geographic Information Science V.25 n.12 pp.1931-1947

Arianoutsou, M.,Koukoulas, S. and Kazanis, D. 2011. Evaluating Post-Fire Forest Resilience Using GIS and Multi-Criteria Analysis: An Example from Cape Sounion National Park, Greece. Environmental Management 47: 384-397

Arponen, A.,Heikkinen,R.K.,Thomas,C.D. and Moilanen,A. 2004. The Value of Biodiversity in Reserve Selection: Representation, Species Weighting, and Benefit Functions. Conservation Biology 19: 2009-2014

Arponen,A.,Kondelin,H and Moilanen,A.2005. Area-Based Refinement for Selection of Reserves Sites with the Benefit-Function Approach. Conservation Biology 21: 527-533

Ars, M.S. and Bohanec, M. 2010. Towards the ecotourisme: A decision support model for the assessment of sustainability of mountain huts in the Alps. Journal of Environmental Management 91: 2554-2564

Bagchi, S., and Mishra, C.,2006. Living with large carnivores: predation on livestock by the snow leopard (Uncia uncia). Journal of Zoology 268(3), 217–224

Bana e Costa,C.and Vasnick,J.C.2008. A critical analysis of the eigenvalue method use to derive priorities in AHP. European Journal of Operational Research 187: 1422-1428

Bello-Pineda, J., Ponce-Hernandez, R. and Liceaga-Correa, M.A.,2006. Incorporating GIS and MCE for suitability assessment modelling of coral reef resources. Environmental Monitoring and Assessment 114: 225-256

Belton ,V.and Pictet, J.,1997.A framework for group decision using a MCDA model: sharing, aggregating, or comparing individual information?. Journal of Decision Systems 6: 283-303

Belton, V., and Stewart,T.S.,2002. Multiple Criteria Decision Analysis. An Integrated Approach. Kluwer Academia Publishers, Massachussets

Bertomeu, M. and Romero,C.2001. Managing forest biodiversity: a zero-one goal programming approach. Agricultural Systems 68: 197-213

Bojórquez-Tapia,L.A., de la Cueva,H., Díaz,S., Melgarejo, D.,Alcantar,G., Solares,M.J., Grobet, G., and Cruz-Bello,G. 2004. Environmental conflicts and nature reserves: redesigning Sierra San Pedro Mártir National Park, Mexico. Biological Conservation 117: 111–126

Borrini-Feyerabend, G.2003.Governance of protected areas-Innovation in the air…IUCN/CEESP Journal Policy Matters, Issue 12, Community Empowerment for Conservation, Sep. 2003

Bouyssou, D.2000. Building criteria: a prerequisite for MCDA, in "*Readings in Multiple Criteria Decision-Aid*", C.A. Bana e Costa (ed.), pp. 58–80, Springer Verlag, Heidelberg, 1990

Bowles, S., and Gintis, H. 2003.The evolution of strong reciprocity: cooperation in heterogeneous populations. Theoretical Population Biology 65:17-28

Brown,G.G. and Reed, P. 2009. Public participation GIS: A new method for use in National Forest Planning. Forest Science 55 :166-182

Cailloux, O., Meyer, P. and Mosseau, V. 2012. Eliciting ELECTRE TRI category limits for a group of decision makers. European Journal of Operational Research 223: 133-140

Carver,S., Comber, A.McMorran, R. and Nutter,S. 2012. A GIS model for mapping spatial patterns and distribution of wild land in Scotland. Landscape and Urban Planning 104: 395-409

Cook, D. and Proctor, W.2007. Assessing the threat of exotic plant pests. Ecological Economics 63: 594-604

Copeland,H.E.,Ward,J.M. and Kiesecker, J.M.2007. Assessing tradeoffs in biodiversity, vulnerability and cost when prioritizing conservation sites. Journal of Conservation Planning 3: 1-16

Cordier, M., Perez Agundez, J.A., O'Connor, M.,Rochette, S. and Hecq, W. 2011. Quantification of interdependencies between economic systems and ecosystem services: An input-output model applied to the Seine estuary. Ecological Economics 70: 1660-1671

Costello,C. and Polasky,S.2004. Dynamic reserve site selection.Resource and Energy Economics 26: 157-174

Cuwenbergh,N.van,Pinte,D.,Tilmant,A.,Frances,I.Pulido-Bosch.A and Vanclooster,M.2008. Multi-objective, multiple participant decision support for water management in the Andarax catchment, Almeria. Environmental Geology 54: 479-489

Davis, F.W., Costello, C. and Stoms, D. 2006. Efficient Conservation in a Utility-Maximization Framework. Ecology and Society 11:33

Dearden, P.,Bennett,M. and Johnston, J. 2005.Trends in Global Protected Area Governance, 1992-2002. Environmental Management 36 : 89-100

Dhar, A., Ruprecht, H. And Vacik, H.2008.Population viability risk management (PVRM)for in situ management of endangered tree species –A case study on a Taxus baccata L. Population . Forest Ecology and Management 255: 2835-2845

Diaz-Balteiro, L and Romero, C. 2008. Making forestry decisions with multiple criteria: A review and an assessment. Forest Ecology and Management 255 : 3222–3241

Dong ,Y., Zhang,G.,Hong, W and Xu Y.,2010. Consensus model for AHP group decision making and the row geometric mean priorization methods. Decision Support Systems 49:281-289

Dudley, N. (Ed.). 2008. Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN .x+86 pp.

Duke, J.M. and Aull-Hyde, R. 2002. Identifying preferences for land preservation using the analytic hierarchy process. Ecological Economics 42: 131-145

Durbach, I.N. and Stewart, T.J.2012. A comparison of simplified value function approaches for treating uncertainly in multiple-criteria decision analysis. Omega 40: 456-464

Durbach., I.N. and Stewart, T.J. 2012.Modeling uncertainly in multiple-criteria decision analysis. European Journal of Operational Research 223:1-14

EUROPARC-España. 2009. Anuario EUROPARC-España del estado de los espacios naturales protegidos. Fundación Fernando González Bernálbez, Madrid, p.160

Eyvindson, K, Hujala, T, Kangas, A. and Kurttila, M.2012. Selecting a forest plan among alternatives: Consistency of preferences within decision support framework. Forest Policy and Economics 15: 114-122

Figueira, J.,Greco,S. and Ehrgott, M. Multiple Criteria Decision Analysis. State of the Survey.Ed. Springuer Science +Bussiness Media, Inc,,2005

Fizsimons,F.,Pearson,C.J,Lawson,C. and Hill, M.J.2012. Evaluation of land-use planning in greenbelts based on intrinsic characteristics and stakeholder values. Landscape and Urban Planning 106: 23-34

Fu, Ch. And Yang,S.2012. An evidential reasoning based consensus model for multiple attribute group decision analysis problems with interval-valued group consensus requeriments. European Journal of Operational Research 223: 167-176

Fuller,D.O., Meijaard,E.M.,Christy, L. and Jessup, T.C., 2010. Spatial assessment of threats to biodiversity within East Kalimantan, Indonesia. Applied Geography 30: 416-425

Furstenau,C.,Badeck, F.W.,Lasch,P.,Lexer, M.J.,Lindner,M.,Mohr,P. and Suckow,F. 2007.Multiple-use forest management in consideration of climate change and the interests of stakeholder groups. European Journal of Forest Resources 126:225-239

García-Melón,M.,Gómez-Navarro,T. and Acuña-Dutra, S. 2010. An ANP approach to assess the sustainability of Tourist strategies for the Coastal National Parks of Venezuela. Technological and Economic Development of Economy 16(4): 672-689

Geneletti , G.and Duren van,I.,2008. Protected area zoning for conservation and use: A combination of spatial multicriteria and multiobjective evaluation. Landscape and Urban Planning 85: 97-110

Graham, J, Amos, B and Plumptre, T.2003.Governance Principles for Protected Areas in the 21st. Century. Fifth World Parks Congress, South Africa in September 2003

Graziano, R.,Gilberto,P and Alessandro, F.2009. A rapid and cost-effective tool for managing habitats of the European Natura 2000 network:a case study in the Italian Alps. Biodiversity Conservation 18: 1375-1388

Gregory , R. and Keeney,R.L., 1994.Creating Policy alternatives using stakeholders value .Management Science 40:1035-1048

Gregory, R. and Wellman, K.2001. Bringing stakeholder value into environmental policy choices: a community-based estuary case study. Ecological Economics 39: 37-52

Hamalainen, R.P., Kettunen, E. and Ehtamo, H.2001. Evaluating a Framework for Multi-Stakeholder Decision Support in Water Resources Management. Group Decision and Negotiation 10:331-353

Hayashi,K.2000.Multiple-criteria analysis for agricultural resource management: a critical survey and future perspectives. European Journal Research 122:486-500

Hajehforooshnia, S.,, Soffianian, A., Mahinyc, A.S. and Fakheran, S. 2011. Multi objective land allocation (MOLA) for zoning Ghamishloo Wildlife Sanctuary in Iran. Journal for Nature Conservation 19 : 254– 262

Hajkovicz, S.A. 2007. A comparison of multiple criteria analysis and unaided approaches to environmental decision making. Environmental Science and Policy 10:177-184

Hajkowicz, S.A.,Higgins, A.,Williams, K.,Faith, D.P. and Burton, M.2007.Optimisation and the selection of conservation contracts.The Australian Journal of Agricultural and Resource Economics,51, pp.39-56

Hajkowicz, S. and Collins, K., 2007.A Review of Multiple Criteria Analysis for Water Resource Planning and Management. Water Resources Management 21:1553–1566

Hajkowicz,S.2008. Supporting multi-stakeholder environmental decisions. Journal of Environmental Management 88 : 607–614

Harrison, S.R. and Qureshi, M.E.2000. Choice of stakeholders groups and members in multicriteria decision models. Natural Resources Forum 24: 11-19

Hajkowicz, S. 2009, Cutting the cake: Supporting environmental fund allocation decisions. Journal of Environmental Management 90: 2737–2745

Herath, G.,2004. Incorporating community objectives in improved wetland management:the use of the analytic hierarchy process. Journal of Environmental Management 70 :263–273

Hiltunenen,V.,Kurttila,M.,Leskinen,P.,Pasanen,K. and Pykalainen, J.2009. Mesta: An internet-based decision-support application for participatory strategic-level natural resources planning. Forest Policy and Economics 11:1-9

Hjorsto, C.N.2004. Enhancing public participation in natural resource management using Soft OR- an application of strategic option development and analysis in tactical forest planning. European Journal of Operational Research 152: 667-683

Howarth,R.B. and Wilson, M.A.2006. A theoretical approach to deliberative valuation: Aggregation by mutual consent. Land Use 82:1-16

Huang , I., Keisler ,J. and Linkov, I. 2011. Multi-criteria decision analysis in environmental sciences:Ten years of applications and trends. Science of the Total Environment 409 : 3578–3594

Huth, A., Dreschler, M. and Kohler, P. 2004. Multicriteria evaluation of simulated logging scenarios in a tropical rain forest. Journal of Environmental Management 71: 321-333

Huth,A.,Dreschler,M and Kohler,P.2005. Using multicriteria decision analysis and a forest growth model to assess impacts of tree harvesting in Dipterocarp lowland rain forest. Forest Ecology and Management 207: 215-232

IUCN-TILCEPA 2010. Joint PAEL-TILCEPA workshop on Protected Areas Management Evaluation and Social Assessment of Protected Areas. Gland, Switzerland: IUCN. 17 pp

IUCN and UNEP-WCMC, 2011. Acceso en abril 2012 http://www.wdpa.org/Statistics.aspx

Janssen,R.,Goosen, H.,Verhoeven,M.L.,Verhoeven, J.T.A.,Omtzigt, A.Q.A. and Maltby, E. 2005.Decision support for integrated wetland management.Environmental Modelling and Software 20:215-229

Janssen,R.,2001. On the use of multiple-criteria analysis in environmental impact assessment in The Netherlands. Journal of Multi-Criteria Decision Analysis 10: 101-109

Janssen, J.A.E.B.,Krol,M.S.,Schielen, R.M.J. and Hoekstra, A.Y. 2010. The effect of modeling expert knowledge and uncertainty on multicriteria decision making: a river management case study. Environmental Science and Policy 13: 229-238

Kangas, A. and Kangas, J.,2004. Probability, possibility and evidence: approaches to considerer risk and uncertainly in forestry decision analysis. Forest Policy Econon. 6: 169-188

Kangas,.J. and Leskinen, P.,2005. Modelling ecological expertise for forest planning calculations-rationale, examples, and pitfalls. Journal of Environmental Management 76: 125-133

Kazana, V.,Fawcett, R.H. and Mutch, W.E.S.2003. A decision support modeling framework for multiple use forest management: The Queen Elizabeth Forest case study in Scotland. European Journal of Operational Research 148: 102-115

Kennedy, M.C., Ford, E.D., Singleton, P, Finney,M.and Agees, J.K. 2008. Informed multi-objective decision-making in environmental management using Pareto optimality. Journal of Applied Ecology 45: 181-192

Kijazi, M.H. and Kant, S. 2011. Social acceptability of alternative forest regimes in Mount Kilimanjaro, Tanzania, using stakeholder attitudes as metrics of uncertainly. 2011. Forest Policy and Economics 13: 242-257

Kiker,G.A., Bridges,T.S.,Varghese,A,Seager,, T.P. and and Linkovjj, I. 2005. Application of Multicriteria Decision Analysis in Environmental Decision Making. Integrated Environmental Assessment and Management . Volume 1 : 95–108

Korhonen, P.,Moskowitz, H.,Wallenius, J.1992. Multiple criteria decision support. A review.European Journal Research 63:361-375

Kothari , A.,2008. People and Parks.Parks 17: Nº 2 Durban +5

Kurttila, M., Pukkala, T and Loikkanen, J.2002. The performance of alternative spatial objective types in forest planning calculations : a case for flying squirrel and moose. Forest Ecology and Managemnt 166: 245-260

Kurttila, M., Pykalainen, J and Leskinen, P. 2006. Defining the forest landowner's utility-loss compensative subsidy level for a biodiversity object. European Journal Forest Res 125:67-78

Lange de,W.J., Stafford, W.H.L., Forsyth, G.G. and Maitre Le, D.C.,2012 Incorporating stakeholders preferences in the selection of technologies for using invasive alien plants as a bio-energy feedstock: Applying the analytical hierarchy process. Journal of Environmental Management 99: 76-83

Lawson, S.R. and Manning, R.E. 2003. Integrating multiple wilderness values into a decision-making model for Denali National Park and Preserve. Journal for Nature Conservation 11: 355-362

Lemos, M.C. and Agrawal,A. 2006. Environmental Governance. Annual Review Environment Resources 31:297-325

Lennox,J.,Proctor,W.and Russell,S. 2011. Structuring stakeholder participation in New Zealand's water resource governance. Ecological Economics 70: 1381-1394

Leverington,F.,Hockings,M.,Pavese, H.,Lemos Costa,K and Courrau,J.2008.Management effectiveness evaluation in protected areas-A global study. Supplementary report n1: Overview with approaches and methodologies. Th e University of Queensland, Gatton, TNC,WWF,IUCN,-WCPA-Australia.

Leverington, F., Lemos Costa, K., Pavese, H., Lisle, A.and Hockings, M .2010. A Global Análisis of Protected Area Management Effectiveness. Environmental Management 46, 685-698

Liu, S.,Proctor, W. And Cook, D.2010. Using an integrated fuzzy set and deliberative multi-criteria evaluation approach to facilitate decision-making in invasive species management. Ecological Economics 69: 2374-2382

Liu, S., Sheppard, A., Kriticos, D and Cook,D., 2011. Incorporating uncertainty and social values in managing invasive alien species: a deliberative multi-criteria evaluation approach- Biological Invasions 13:2323–2337

Liu, S., Walshe, T., Long, G. and Cook, D. 2011. Evaluation of potencial responses to invasive non-native species with structured decision making. Conservation Biology v.26 n.3: 539-546

Liu, X.,Lao,C.,Li, X.,Liu, Y and Chen, Y. 2012. An integrated approach of remote sensing, GIS and swarm intelligence for zoning protected ecological areas. Landscape Ecology 27: 447-463

Lockwood, M. 2010. Good governance for terrestrial protected areas: A framework, principles and performance outcomes. Journal of environmental management 91:754-766

López, A., Pons, A and Noguera,M.2007. Use of the IUCN protected areas management categories in the Mediterranean region. Consejería de Medio Ambiente de la Junta de Andalucía, Sevilla, España and IUCN, Gland, Suiza y Málaga.

Macharis,C., Springael,J.,de Brucker,K and Verbeke,A.,2004. PROMETHEE and AHP: The design of operational synergies in multicriteria analysis. Strenghtening PROMETHEE with ideas of AHP. European Journal of Operational Research 153: 307-317

Maguire, L.A. 2004. What can Decision Analysis Do for Invasive Species Management?. Risk Analysis 24: 859-868

Marchamalo, M and Romero, C. 2007. Participatory decision-making in land use planning:An application in Costa Rica. Ecological Economics 63: 740-748

Marianov,V., ReVelle, Ch.,and Snyder ,S.2008. Selecting Compact habitats reserve for species with differential habitat size needs. Computer and Operations Ressearch 35:475-487

Maroto,C.,Alcazar,J.,Ginestar,C. and Segura,M.2012. Investigación Operativa en Administración y Dirección de Empresas. Valencia:Editorial Universitat Politecnica de Valencia.

Marshall, G., McNeill,J and Reeve, I.J.2011.Economics for accountability in community-based environmental governance. Working paper 2 from the project "Improving economic accountability when using descentralised, collaborative approaches to environmental decisions". Institute for Rural Futures. University of England,Armidale. June 2011

Marttunen,M and Hamalainen,P.1995.Decision analysis interviews in environmental impactassessment. European Journal of Operational Research 87: 551-563

Marttunen, M. and Hamalainen, P. 2008. The Decision Analysis Interview Approach in the Collaborative Management of a Large Regulated Water Course. Environmental Management 42: 1026-1042

Masozera, M.K.,Alavalapati, J.R.R.,Jacobson, S.K. and Shrestha, R.K. 2006. Assessing the suibality of community-based management for the Nyungwe Forest Reserve, Rwanda. Forest Policy and Economics 8:206-216

McShane, T.O., Hirsch, P.D., Trung, T.C.,Songorwa, A.N., Kinzig,A.,Monteferri,B.,Mutekanga, D.,van Thang, H., Dammert, J.L.,Pulgar-Vida, M.,Welch-Devine, M.Brosius, J.P., Coppolillo, P. and O'Connor, S. 2011. Hard choices: Making trade-offs between biodiversity conservation and human well-being. Biological Conservation 144: 966-972

Meir,E.,Andelman, S.and Possingham, H.2004.Does conservation planning matter in a dynamic and uncertain world? Ecology Letters 7:615-622

Memtsas, D.,P. 2003. Multiobjective programming methods in the reserve selection problem. European Journal of operational research 150: 640-652

Mendoza, G.A. and Prabhu, R.2000. Development of a Methodology for Selecting Criteria and Indicators of Sustainable Forest Management: A Case Study on Participatory Assessment. Environmental Management 26:659-673

Mendoza, G.A. and Prabhu, R.,2001. A Fuzzy Analytic Hierarchy Process for Assessing Biodiversity Conservation. In The Analytical Hierarchy Process in Natural Resource and Environmental Decision Making. Ed. Kluwer Acdemic Publishers,2001

Mendoza, G.A. and Martins, H. 2006. Multi-criteria decision analysis in natural resource management:A critical review of methods and new modelling paradigms. Forest Ecology and Management 230 : 1–22

Moffet,A., Garsson, J. and Sarkar,S.2005. MultCSync: a software package for incorporating multiple criteria in conservation planning. Environmental Modelling and Software 20: 1315-1322

Moffett,A. and Sarkar, S.,2006. Incorporating multiple criteria into the design of conservation area networks: a minireview with recommendations.Diversity and Distributions 12: 125-137

Moilanen,A.2005. Methods for reserve selection:Interior point search. Biological Conservation 124: 485-492

Moilanen. A.,Franco, A.M.C.,Early, R.I.,Fox, R.,Wintle, B. and Thomas, C.2005. Prioritizing multiple-use landscapes for conservation : methods for large multi-species planning problems. Proceedings of The Royal Society 272: 1885-1891

Moilanen,A.,Wintle, B.A.,Elith,J. and Burgman,M.2006.Uncertainty Analysis for Regional-Scale Reserve Selection. Conservation Biology 20: 1688-1697

Moilanen,A.,Runge,M.C.,Elith,J.,Tyre,A.,Carmel,Y.,Fegraus,E.,Wintle,B.A.,Burgman, M and Ben-Haim,Y.2006. Planning for robust reserve networks using uncertainty analysis. Ecological Modelling 199: 115-124

Moilanen, A.2007. Landscape Zonation, benefit functions and target-based planning: Unifying reserve selection strategies. Biological Conservation 134:571-579

Moilanen,A. and Wintle,B.A.2007. The Boundary-Quality Penalty a Quantitative method for Approximating Species Respones to Fragmentation in Reserve Selection.Conservation Biology 21:355-364

Moilanen, A.2008. Two paths to a suboptimal solution –once more about optimally in reserve selection. Biological Conservation 141: 1919-1923

Moilanen, A., Leathwick,J. and Elith, J. 2008.A method for spatial freshwater conservation prioritization. Freshwater Biology 57: 577-592

Moilanen, A. and Arponen, A.2011.Setting conservation tardgets under budgetary constraints. Biological Conservation 144:650-653

Moilanen, A. and Cabeza, M.2007. Accounting for habitat loss rates in sequencial reserve selection: Simple methods for large problems. Biological Conservation 136: 470-482

Myllyviita, T; Hujala, T, Kangas, A and Leskinen, P. ,2011.Decision Support in Assessing the Sustainable Use of Forests and Other Natural Resources - A Comparative Review. The Open Forest Science Journal,4: 24-41

Mrosek, T.,Balsillie,D. and Schleifenbaum,P.2006.Field testing of a criteria and indicators system for sustainable forest management at the local level. Case study results concerning the sustainability of the private forest Haliburton Forest and Wildlife Reserve in Ontario, Canada.Forest Policy and Economics 8:593-609

Munda.,2004. Social multi-criteria evaluation: Methodological foundations and operational consequences. European Journal of Operational Research 158 : 662-677

Munda, G. and Saisana,M. 2011.Methodological Considerations on Regional Sustainability assessment based on multicriteria and sensibility analysis. Regional Studies 45.2: 261-276

Muñoz-Santos,M. and Benayas, J. 2012. A Proposed Methodology to Assess the Quality of Public Use Management in Protected Areas. Environmental Management 50: 106-122

Mustajoki, J.,Hamalainen, R.P. and Marttunen, M.2003. Participatory multicriteria decision analysis with Web-HIPRE: a case of lake regulation policy. Environmental Modelling and Software 19: 537-547

Mustajoki ,J.,Saarikoski, H., Marttunen, M., Ahtikoski, A., Hallikainen, V., Helle, T.,Hyppönen, M., Jokinen, M., Naskali, A.,Tuulentie, S.,Varmola, M.,, Vatanen, E. and Ylisirniö, A., 2011. Use of decision analysis interviews to support the sustainable use of the forests in Finnish Upper Lapland. Journal of Environmental Management 92 : 1550-1563

Nordstrom, E., Eriksson, L.O. and Ohman, K.2010. Integrating multiple criteria decision analysis in participatory forest planning: Experience from a case study in northern Sweden. Forest Policy and Economics 12: 562-574

OAPN. 2010. Annual Report 2010. Organismo Autónomo de Parqeus Nacionales .Ministerio de Medio Ambiente. Madrid.

Oikonomou,V.,Dimitrakopoulos, P.G. and Troumbis, A.Y.,2011. Incorporating Ecosystem Functio Concept in Environmental Planning and Decision Making by

Means of Multi-Criteria Evaluation: The Case-Study of Kalloni, Lesbos, Greece. Environmental Management 47:77-92

Oliveira, F.,de., Patias Volpi,N.M. and Sanquetta, C.R. 2003. Goal programming in a planning problem. Applied Mathematics and Computation 140: 165-178

Ormazábal, G.2002. El IDS: Un nuevo sistema integrado de toma de decisiones para la gestión de proyectos constructivos. Tesis Doctoral. Universitat Politècnica de Catalunya

Orsi, F. and Geneletti, D.2010. Identifying priority areas for Forest Landscape Restoration in Chiapas (Mexico): An operational approach combining ecological and socioeconomic criteria. Landscape and Urban Planning 94: 20-30

Ostrom.,E.2000. Collective Action and the Evolution of Social Norms. Journal of Economics Perspectives 14:3, 137-158

Ostrom, E.2009.A general Framework for Analyzing Sustainability of Social-Ecological Systems. Science 325, 419-422

Pasqualini,V.,Oberti,P.,Vigetta,S.,Riffard,O.,Panaiotis,C.,Cannac,M. And Ferrat, L. 2011. Environmental Management 48:38-56

Paavola, J.2005. Environmental justice and governance: theory and lessons from the implementation of the European union’s habitats directive. CSERGE Working Paper EDM 03-05

Pavlikakis, G.E. and Tsihrintzis, V.A.2003. Integrating humans in ecosystem management using multi-criteria decision making. Journal of the American Water resources Association April, pp.277-288

Pecci, A.,Patil,G.,Rossi, O. And Rossi, P.2010.Biodiversity protection funding preference: a case study of hotspot geoinformatic and digital governance for the Map of Italian Nature in the presence of multiple indicators of ecological value, ecological sensitivity and anthropic preassure for the Oltrepò Pavese and Ligurian-Emilian Apennine study area in Italy. Environmental Ecology Stat.17:473-502

Phua,M. and Minowa,M.2005. A GIS-based multi-criteria decision making approach to fores conservation planning at a landscape scale : a case study in the Kinabalu Area, Sabah, Malaysia. Landscape and Urban Planning 71:207-222

Pierce, S.M., Cowling, R.M., Knight, A.T.,Lombard, A.T., Rouget, M. and Wolf, T.2005. Systematic conservation planning products for land-use planning: Interpretation for implementation. Biological Conservation 125: 441-458

Pomero, J.C. and Barba-Romero, S.,2000. Multicriterion Decision Management. Principles and Practice. Ed. Kluwer's International Series,2000

Prato, T.1999. Multiple attribute decision analiysis for ecosystem management. Ecological Economics 30:207-222

Prato, T.2000. Multiple attribute evaluation of landscape management. Journal of Environmental Management 60: 325-337

Prato,T.,2001. Modeling carrying capacity for national parks. Ecological Economics 39: 321-331

Prato, T. 2003. Multiple-attribute evaluation of ecosystem management for the Missouri River system. Ecological Economics 45: 297-309

Prato, T., 2006. Adaptive management of national parks. George Wright Society 23, 72–86.

Prato, T.,Clarck,A.S.,Dolle, K. and Barnett,Y.2007. Evaluating alternative economic growth rates and land use policies for Flathead County, Montana. Landscape and Urban Planning 83: 327-339

Prato, T. 2008.Evaluating land use plans under uncertainly. Land Use Policy 24: 165-174

Prato, T. 2008. Stochastic multiple attribute evaluation of land use policies. Ecological Modelling 219: 115-124

Prato, T.,2009. Evaluating and managing wildlife impacts of climate change under uncertainly. Ecological Modelling 220: 923-930

Proctor ,W and Dreschler, M. 2003. Deliberative Multi-criteria Evaluation: A case study of recreation and tourisme options in Victoria Australia. European Society for Ecological Economics, Febr.11-15,2003

Rauschmayer, F. and Wittmr, H. 2006. Evaluating deliberative and analytical methods for the resolution of environmental conflicts. Land Use Policy 23: 108-122

Rayfield, B., Molainen,A. and Fortin, M.J.2009.Incorporating consumer-resource spatial interactions in reserve design. Ecological Modelling 220:725-733

Reynolds, K.2001. Prioritzing Salmon Habitat Restoration with AHP, SMART, and Uncertain Data. In "The Analytic Hierarchy Process in Natural Resource and

Environmental Decision Making". Schmoldt,D.,Kangas,J.,Mendoza,G.A. and Pesonen, M., Ed. Kluwer Academic Publishers,2001.-pp.199-217

Romero, C.1993. Teoría de la decisión multicriterio: Conceptos, técnicas y aplicaciones. Ed. Alianza Universidad Textos

Romero-Calcerrada, R. and Luque, S.2006. Habitat quality assessment using Weights-of-Evidence based GIS modelling: The case of *Picoides trydactylus* as species indicator of the biodiversity value of the Finnish forest. Ecological Modelling 196: 62-76

Roy, B.,1996. Multicriteria Methodology for Decision Aiding. Ed. Kluwer Academic Publisher

Roy,B.2005 : Paradigms and challenges , in Multiple Criteria Decision Analysis. State of the survey .Figueira , J., Greco,S and Ehrgott, M.,2005

Rudolphi,W. and Haider, W. 2003. Visitor management and ecological integrity: one example of an integrated management approach using Decision Analysis. Journal for Nature Conservation 11: 346-354

Ruliffson, J.A.,Haugth, R.G., Gobster, P.H. and Homans, F.R.2003. Metropolitan natural area protection to maximize public access and species representation. Environmental Science and policy 6: 291-299

Saaty,T and Vargas, L.2001. Models, methods, concepts and applications of the Analytic Hierarchy Process. Kuwer's Academic Publishers. Boston/Dordrecht/London

Saaty,T.,2005. The Analytic Hierarchy and Analytic Network Process for the Measrument of Intangible Criteria and for Decision-making. In Figueira, J.,Greco,S. and Ehrgott, M. Multiple Criteria Decision Analysis. State of the Survey.Ed. Springuer Science +Bussiness Media, Inc,,2005

Sabatini, M.C., Verdiell, A.,Rodriguez Iglesias, R.M. and Vidal, M.2007.A quantitative method for zoning of protected areas and its spatial ecological implications. Journal of Environmental Management 83: 198-206

Schmoldt, D.L. and Peterson, D.L.2000. Analytical group decision making in natural resources: methodology and application. Forest Science 46: 62-75

Schmoldt.D.L. and Peterson,D.L.2001. Strategic and Tactical Planning for Managing National Park Resources. In . In "The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making". Schmoldt, D.,Kangas,J.,Mendoza,G.A. and Pesonen, M., Ed. Kluwer Academic Publishers,2001.-pp.67-79

Sharifi, M.A., Toorn, van den W.,Rico, A. and Emmanuel, M.2002. Application of GIS and Multicriteria Evaluation in Locating Sustainable Boundary between the Tunari

Nacional Park Cochabamba City (Bolivia). Journal of Multi-criteria Decision Analyisis 11: 151-164

Sigel, K.,Klauer, B. and Pahl-Wostl, C.2010. Conceptualising uncertainly in environmental decision-making: The example of the EU ater framework directive. Ecological Economics 69: 502-510

Siitonen, S., Tanskanen, A. and Lehtinen, A.2002. Method for Selection of Old-Forest Reserves. Conservtion Biology 16: 1398-1408

Siitonen, P.,Tanskanen, A. and Lehtinen, A.2003. Selecting forest reserves with a multiobjective spatial algorithm. Environmental Science and Policy 6: 301-309

Silva, V.B.,Morais, D.C. and Almeida, A.T.2010. A Multi-criteria Group Decision Model to Support Watershed Committees in Brazil. Water Resources Management 24: 4075-4091

Store, R. and Kangas, J.2001. Integrating spatial multi-criteria evaluation and expert knowledge for GIS-based habitat suitability modeling. Landscape and Urban Planning 55: 79-93

Store, R. and Jokimaki, J.2003. A GIS-based multi-scale approach to habitat suitability modeling. Ecological Modelling 169: 1-15

Strager, M.P. and Rosenberguer, R.S. 2006. Incorporating stakeholders preferences for land conservation : Weights and measures in spatial MCA. Ecological Economics 58: 79-92

Teeffelen, A.J.A.van., Cabeza, M. and Moilanen, A.2006. Connectivity, probabilities and persistence: comparing reserve selection strategies. Biodiversity and Consevation 15: 899-919

Theobald, D.M. and Hobbs, N.T.2002. A framework for evaluating land use planning alternatives: protecting biodiversity on private land. Conservation Ecology 6:5

Theobald, D.M.N., Hobbs, N.T., Bearly, T, Zack, J.A.,Shenk,T. and Riebsame, W.E.2000.Incorporating biological information in local land use decision making: designing a system for conservation planning. Landscape Ecology 15:35-45

Thirumalaivasan, D.,Karmegam,N. and Venugopal,K.2003. AHP-DRASTIC : Software for specific aquifer vulnerability assessment using DRASTIC model and GIS. Environmental Modelling and Software 18: 645-656

Thyl de Lopez, T. 2003. Economics and stakeholders of Ream National Park, Cambodia. Ecological Economics 46, 269-282

Tran,L.T.,Knight,C.G.,O'Neill,R.V.,Smith,E.,Riitters,K.H. and Wickham, J. 2002. Environmental Assessment.Fuzzy Decision Analysis for Integrated Environmental Vulnerability Assessment of the Mid-Atlantic Region. Environmental Management 29: 845-859

Tran, L.T., Knight, C.G., O'Neill, R.V. and Smith, E.2004. Integrated environmental assessment of the Mid-Atlantic Region with Analytical Network Process. Environmental Monitoring and Assessment 94:263-277

Tseng,M.L. 2011. Using a hybrid MCDM model to evaluate firm environmental knowledge management in uncertainty. Applied Soft Computing 11: 1340-1352

Tzionas, P, Ioannidou, I.A. and Paraskevopoulos, S. 2004. A Hierarchical fuzzy Decision Support System for the Environmental Rehabilitation of Lake Koronia, Greece. Environmental Mangement 34: 245-250

UNDP, 1994. Good governance and sustainable human development

Vantanen,A. and Marttunen,M.2005.Public involvement in multi-objective water level regulation development projects –evaluating the applicability of public involvement methods. Environmental Impact Assessment Review 25: 281-304

Vimal, R., Pluvinet, P.,Sacca, P., Mazagol, P.O., Etlicher, B. and Thompson, J.D.2012. Explorating spatial patterns of vulnerability for diverse biodiversity descriptors in regional conservation planning. Journal of Environmental Management 95: 9-16

Weintraub, A.,Romero,C.,Bjorndal,T. and Epstein, R. 2007. Handbook of Operations Research in Natural Resources. Ed. Springer Science+Bussiness Media LLC.,2007

Whitfield, S., Geist, H.J. and Ioris, A.A.R. 2011. Deliberative assessment in complex socioecological systems: recommendations for environmental assessment in drylands. Environmental Monitoring Assessment 183: 465-483

Wood,L.J. and Dragicevic,S.2007. GIS-based multicriteria evaluation and fuzzy sets to identify priority sites for marine protection. Biodiversity Conservation 16: 2539-2558

Wolfslehner, B. and Vacik, H.2008. Evaluating sustainable forest management strategies with the Analytic Network Process in a Pressure-State-Response framework. Journal of Environmental Management 88: 1-10

Wolfslehner, B. and Vacik, H.2011. Mapping indicator models : From intuitive problem structuring to quantified decision making in sustainable forest management. Ecological Indicator 11:274-283

Yilmaz,B. and Harmancioglu,N.B.,2010.Multi-criteria decision making for water resource management: A case study of the Gediz River Basin, Turkey. Water SA 36 :563-576

Young, J.A., van Manen, F.T. and Thatcher, C.A. 2011. Geographic Profiling to Assess the Risk of Rare Plant Poaching in Natural Areas. Environmental Management 48: 577-587

Zendehdel , K., Rademaker ,M., De Baets, B. and , Van Huylenbroeck, G. Environmental decision making with conflicting social groups: A case study of the Lar rangeland in Iran. Journal of Arid Environments 74: 394-402

Zerger, A., Warren, G., Hill, P.,Robertson, D.,Weidemann, A. and Lawton, K. 2011. Multi-criteria assessment for linking regional conservation planning and farm-scale actions. Environmental Modelling and Software 26:103-110

Zia, A., Hirsch, P, Songorwa, A., Mutekanga, D.R., O'Connor, S.,McShane, T., Brosius, P. and Norton, B. 2011. Cross-Scale Value Trade-Offs in Managing Social-Ecological Systems: The Politics of Scale in Ruahna National Park, Tanzania. Ecology and Society 16 (4): 7

Zimmermann, H.J.,2000. An application-oriented view of modeling uncertainly. European Journal of Operational Research 122: 190-198

Zucca, A.,Sharifi, A.M. and Fabbri, G. 2008. Application of spatial multi-criteria analysis to site selection for a local park: A case study in the Bergamo Province, Italy. Journal of Environmental Management 88: 752-769.

SECCIÓN III. LA GESTIÓN DE LAS ÁREAS PROTEGIDAS DESDE EL BUEN GOBIERNO. CAPÍTULO 4

Parque Natural Marjal de Pego-Oliva (España). Foto: V. Urios.

IDENTIFYING EQUIVALENCES WITH PROTECTED AREA INTERNATIONAL CATEGORIES USING MULTI-CRITERIA ANALYSIS IN COLABORATIVE DECISION-MAKING.

Mónica de Castro* and Vicente Urios

CIBIO- Estación Biológica Terra Natura, Universidad de Alicante, Campus San Vicente del Raspeig s/n, Edificio Ciencias III, 03080 Alicante, Spain

ABSTRACT

The evaluation of international management in protected areas presents serious issues, given the heterogeneity in assigning categories of protection. The IUCN management categories system has been very helpful in promoting protected area networks in many countries, reduce confusion and establish worldwide comparable databases, including the World Database Protected Areas (WDPA). On the other hand the use of Multi-criteria Analysis in colaborative decision making can incorporate stakeholders' preferences into the decision-making in a structured way. This paper presents a Multi-criteria Decision Support Model capable of incorporating stakeholders preferences based on the PROMETHEE method. This model allows to obtains priorities on the management objectives of the stakeholders in a protected area and identify equivalences with IUCN protection categories. It also presents an application in the Albufera Natural Park in Valencia, a strongly man-modified wetland locted in Estern Spain. This paper is a contribution to the development of comparable information systems in the worldwide network of protected areas and helps to improve the evaluation of their management, incorporating the principles of good governance.

Key Words:

Multi-criteria Analysis, Participation, Stakeholders, IUCN Protection Categories, Protected Areas Management, PROMETHEE

1. INTRODUCTION

Management effectiveness evaluation (MEE) is defined as "the assessment of how well the protected area is being managed-primarily the extent to wich is protecting values and achieving goals and objectives" (Hockings et al., 2006) . Recent assessments of management effectiveness in protected areas highlight the need to standardize the methodology of ecological monitoring and nature science-based research in order to make possible systematic comparisons among possible protected areas (Klemann Stoll, 2010). Major international agreements such as the Convention on Biological Diversity have called for adopting a single international classification system and has supported the IUCN to review and adapt the system to new challenges (COP 11).

The protected areas management categories system of the IUCN has been very helpful in promoting protected area systems in many countries, reduce confusion and establish globally comparable databases, as is the case of the Protected Areas United Nations Database (WDPA). However, many countries like Spain not only failed to adapt its system of protected areas to the international reference system, but also present great disparity between the regional and national systems of protected areas. This creates confusion, coordination problems and complicates the assessment and monitoring of protected areas (López Ornat et al.,2007).

The latest guidelines revision of IUCN shows subtle but important changes to the definition of a protected area, giving greater emphasis to nature conservation, long term protection and management effectiveness (Dudley et al., 2010). On the other hand, in the last decade a new paradigm of protected areas arises, being based on the principles of good governance that gives importance to the participation of local communities (Abrams et al., 2003, Lockwood et al., 2006; Lockwood, 2010). The strong conflicts between stakeholders, the large number of agents linked to protected areas with adverse interests and the complex relationships between them have increased the need to incorporate participation into decision making in protected areas.

However, this new scenrio led to serious problems of lack of communication in various directions, on one hand, among the stakeholders themselves, to defend their interests individually and that often have no possibility to share their different points of view. On the other hand, between governments and stakeholders, since the former are responsible to make effective the restrictions arising from the protection of the area. This issue takes place even among government agencies at different levels of work: local, regional, national and international, with the coordination problems that this entails. Also, in order to make management as efficient as possible, goals and objectives in a protected area must be clear and well defined, and must have clear communication channels capable of providing sufficient information both to different strategic levels and to different agents linked within the decision-making process (Lockwood, 2010).

On the other hand, Multicriteria Analysis can be a useful tool to incorporate the preferences of agents in decision-making processes on natural resource management (Ananda and Herath, 2009; Brucker et al., 2013; Moffet et al. 2006; Weintrub et al., 2007). Multicriteria techniques are especially useful in getting agreement, since they provide a structured framework for the discussion in the decision-making processes. In the last decade the use multi-criteria analysis to solve problems of MCDM management in protected areas has increased (Fitzsimons et al., 2012; Kijazi and Kant, 2011; Mustajoki et al., 2011; Oikonomou et al., 2011, Whitfield et al ., 2011). Multiple attribute decision-making is well suited for park management decision-making because it accounts for multiple attributes of alternative management actions, and can be applied interactively with many participants using computer-based decision support tool, providing a quantitative basis for decisions (Schmoldt et al. 1994; Prato, 2001). The techniques used are those based on the theory of value and utility and hierarchies. Outranking techniques have been rarely used to solve such problems, probably because they require a background that the staff of a protected area does not aways have, although they may be suitable to solve macro-management issues.

There has been a clear increase in participation in decision-making processes that use multi-criteria analysis (Mendoza and Martins, 2006). Furthermore, the use of MCDM in colaborative decision making offers important advantages for the design of public policies: they generate knowledge about the problem and the objectives of the different stakeholders, and provide transparency, fairness and understandability to the process of decision making (Gregory and Keeney , 1994, Nordstrom et al., 2010).

In this paper, we propose a model to identify IUCN protected areas management categories incorporating stakeholders preferences using closeness values. Closeness values mesures the similitude of stakeholders priorities with IUCN priorities for each category of protection. The decision problem is designed in the IUCN framework and its characterization is defined on the basis of seven alternatives, corresponding to the categories of protection, and nine criteria, which correspond to the management objectives. Participation can be incorporated through personal interviews, individual interviews, even through social networks. The ranking of alternatives is obtained using an outranking technique based on the PROMETHEE method (Preference Ranking Organization Method for Enrichment Evaluations; Brans, 1982; Vincke and Brans, 1985), particularly using PROMETHEE II technique. Moreover a method of evaluating model based on a dispersion analysis, an analysis of consistency and expert analysis has been included.

The aim of this paper is to present a tool to identify management priorities for stakeholders and to find equivalences with the categories of protection of the global network of protected areas.

Section 2 describes the model. Section 3 shows an application in a wetland in the metropolitan area of Valencia, the Albufera Natural Park (Spain). Finally, Section 4 provides the conclusions of this work and suggests future research directions.

2. EVALUATION METHODS

The proposed method includes the following steps:

1.Problem Characterization. The IUCN framework and the PROMETHEE approach.

2.Evaluation table based in “closeness values”

3.Individual Ranking

4.Agregation of individual preferences

5.Evaluation of the conjoint results and resolution of conflicts

2.1.Problem Characterization

The IUCN framework

A lot of different systems to assign protection categories in the world's protected areas hinder the task of assessing the effectiveness of management (Klemann Stoll, 2010). In fact, many of these methods do not consider management objectives in defining the protection categories. The objective of the proposed model is to identify the IUCN management category to which a protected area would fit considering the priorities of the stakeholders regarding the objectives of IUCN management.

The modeling of the decision problem considered nine criteria and seven alternatives. Bouyssou (2000) emphasizes the importance that a group of criteria has to be eligible and operative for its "real-world applicability." A family of criteria is eligible when it has a sufficiently small number of criteria for making possible the evaluation of the inter-criteria information and is operative when seen as a solid foundation to move forward in the process of decision making by all decision-makers. In short, the criteria should not be too much, to facilitate its evaluation, must be simple to understand, and should be representative of the problem they define. This model uses criteria endorsed by the international scientific community, that are applied to the current assessment systems in protected areas management (Leverington et al., 2010; Stolton et al., 2010). The criteria correspond to the management objectives on which the IUCN categorization framework is based: Scientific Research, Protection of Wilderness, Biodiversity Preservation, Education, Tourism, Protection of natural resources and Cultural Resources, Ecosystem services, Sustainable Use and Cultural Values and Traditions (Table 1).

Management Objectives	Explanation
Scientific Research	Scientific research and monitoring
Protection of Wilderness	Maintenance in situ of ecosystems and natural and semi-natural viables habitats for species in their natural context. Maintenace of natural areas not modified.
Biodiversity Preservation	Preserve biodiversity since genetic, species and ecosystems level.
Education	Develop public education and values of species and habitats
Tourism	Promove visits and tourist activities and recreation
Protection of natural resources and cultural resources without use	Protection without use of natural and cultural resources
Ecosystems Services	Maintenance of ecosystem services
Sustainable Use	Incentive sustainable use of natural resources
Cultural Values and Traditions	Maintenance of cultural values and traditions that contributes to management objectives or it has threat

Table 1. Management Objectives in Protected Areas (IUCN,2008)

The alternatives correspond to the nine categories of protection defined in the IUCN framework: Ia, Ib, II, III, IV, V and VI (Table 2). In a decision problem, the alternatives may be "untouchable" or can be modified by interactive methods (Pomerol and Barba-Romero, 2000). One of the criticisms that some techniques such as multi-criteria AHP or PROMETHEE have received is the rank reversal problem. This means that, in some cases, the ranking of the alternatives can be reversed when a new alternative is introduced (Macharis et al.,2004). This problem does not affect the proposed model since the alternatives are predetermined, in the same way of the criteria.

Ia.Strict Nature Reserve: Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.

Ib.Wilderness area: Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

II. National Park: Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.

III.Natural Monument or Feature: Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.

IV.Habitat/species Management Area: Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.

V.Protected Landscape/Seascape: A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

VI.Protected Areas with Sustainable Use of Natural Resources: Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Table 2. Protected Area Categories (IUCN,2008)

The PROMETHEE approach

Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) is a multi-criteria technique developed by Brans (1982). This technique belongs to the group of outranking techniques, which provide a raking of the set of alternatives based on improvement relations. An alternative *a* is said to save an outranking relationship with another alternative *b* if, taking into account all the available information regarding the problem and all the preferences of decision makers, there is a strong enough argument to support the conclusion that *a* is at least so good as *b* and there are no strong arguments supporting the contrary (Belton and Stewart., 2002).

PROMETHEE requires information on the weight of the criteria and the preference function. The weight of the criteria shows the relative importance of the criteria considered. The preference function (Pj) translade the diference between the evaluations obtained by two alternatives in terms of a particular criterion, into a preference degree ranging from 0 to 1.

Let

$P_j(a,b)=G_j|f_j(a)-f_j(b)|,$ (1)

$0\leq P_j(a,b)\leq 1,$ (2)

be the preference function associated to the criterion, $f_j(\cdot)$ where G_j is a nondecreasing function of the observed desviation between $f_j(a)$ and $f_j(b)$.

For ease of identification six types of preference function have been proposed (Brans and Mareschal in Figueira et al, 2005).

PROMETHEE allows obtaining aggregate preference indexes (3), positive outranking flows (4), negative outranking flows (5) and net outranking flows (6),

$\Pi_s(a,b)= \sum_{j=1}^{k} P_j(a,b)w_{s,j},$ (3)

$\Phi^+_s(a)=\sum_{x\epsilon A} \Pi_s(x,a),$ (4)

$\Phi^-_s(a)=\sum_{x\epsilon A} \Pi_s(a,x),$ (5)

$\Phi_s(a)= \Phi^+_s(a)- \Phi^-_s(a)$ (6).

For each alternative *a*, belonging to the set A of alternatives, $\Pi_s(a,b)$ is an overall preference index of *a* over *b*, taken into account all the criteria, $\Phi^+_s(a)$ and $\Phi^-_s(a)$. These measure respectively the strength and the weakness of *a* vis-à-vis the other alternatives. $\Phi_s(a)$ represents a value function, whereby a higher value reflects a higher attractiveness of alternative *a* . We call $\Phi_s(a)$ the net flow of alternative *a* for stakeholder *s* (Macharis et al.,2004).

There are several tools in the PROMETHEE family. The most used are PROMETHEE I and II and GAIA plane (Behzadian et al., 2010). PROMETHEE I obtains partial rankings using positive and negative flows. PROMETHEE II works with net flows to obtain an overall ranking of the alternatives. The geometrical analysis for interactive aid

(GAIA) plane displays graphically the relative position of the alternatives in terms of contributions to the various criteria.

2.2. Evaluation table based in "closeness values"

The evaluation table is the starting point of the PROMETHEE method. This model uses an evaluation table that includes the degree of similarity between the priorities of the objectives for each stakeholder and the priorities defined by IUCN for each protection category.

One of the strengths of this model is the simplicity of the process to collect the preferences of decision makers. Continuous models are extremely complex for many stakeholders. On the other hand, some simple techniques as AHP require a large number of inputs and the process for obtaining the preference is large and boring. However, outranking techniques require a small number of inputs. Only the evaluations have to be performed of each alternative on each criterion (Macharis et al., 2004).

This model requires a single evaluation of the importance of management objectives defined by IUCN upon four options: high, medium, low and zero importance. A Likert survey may be appropriate for social preferences because it is understandable and easy. Surveys can be distributed on-line or through social networks, in order that they can reach a wide public, depending on the social agents that you want to include in the process.

In order to determine the input of the evaluation table management objectives priorities are taken as a reference, for each protection category defined by IUCN, as shown in Table 3.

MANAGEMENT OBJECTIVES	Ia	Ib	II	III	IV	V	VI
Scientific Research	1	3	2	2	2	2	3
Wilderness Protection	2	1	2	3	3	-	2
Biodiversity Preservation	1	2	1	1	1	2	1
Ecosystem services	2	1	1	-	1	2	1
Protection of natural resources and cultural resources	-	-	2	1	3	1	3
Tourism	-	2	1	1	3	1	3
Education	-	-	2	2	2	2	3
Sustainable Use of Natural Resources	-	3	3	-	2	2	1
Cultural Values and Traditions	-	-	-	-	-	1	2

(1) Major Objective (2) Secundary Objective (3) Objective potentially applicable

Table 3. Management objectives priorities to define IUCN protection categories (Source: IUCN, 1994; EUROPARC España, 2008)

In order to obtain final evaluations *closeness values* are defined. These are based on deviations in absolute value between the priorities of each management objective for each protection category defined by IUCN and evaluated by each stakeholder. Afterwords, the scores of deviations are reversed so that higher *closeness values* indicate greater similarity with the IUCN priorities. In this way the value 3 indicates complete agreement between the two priorities and the value 0 indicates complete disagreement.

Let,

$cv_j(a,r)=F_j[d_j(a,r)]$ for all the problem alternatives,where

$d_j(a,r)=|p_j(a) - p_j(r)|$

$0\leq d_j(a,r)\leq 3$

and

if $d_j(a,r)= 0$, so $cv_j(a,r)= 3$

if $d_j(a,r)=1$, so $cv_j(a,r)=2$

if $d_j(a,r)=2$, so $cv_j(a,r)=1$

if $d_j(a,r)=3$, so $cv_j(a,r)=0$

Where $cv_j(a,r)$ is the *closeness value* for the criteria j , $d_j(a,r)$ la deviation (absolute value) between the priority of the decision maker and the priority of the reference (IUCN) for the criteria j , $p_j(a)$ is the priority of each management objective for the criteria j and $p_j(r)$ is the priority of the IUCN reference for the criteria j.

The PROMETHEE method requires additional information on the relative importance of the considere criteria (weights). This model does not consider the weights for the criteria explicitly, but is included through priorities on the criteria in the *closeness values*. In this way no information on the trade-off for each decision maker or group of decision makers is lost. One of the main problems of outranking methods is that you lose clarity to visualize the trade-off. Proctor and Dreschler (2003) used PROMETHEE in a deliberative process to identify priority areas for recreation in a region of Australia, incorporating stakeholder preferences, and they find difficult to display trade-offs among the alternatives. Zendedehl et al. (2010) also used an outranking technique, Achieving Respect for Grades by Using Ordinal Scales only (ARGUS), in a deliberative process for incorporating the preferences of agents in management policies on land use in Iran, although they correct the problem of trade-offs visualization by defining Social Intensity Indicators. The *closeness values* correct the problem of viewing the trade-offs, in order that the degree of similarity or closeness between the assessment of each decider and the IUCN evaluation is always displayed.

2.3. Individual Ranking

The analyst will use the evaluation based in closeness values to calculate theindividual results, through the use of PROMETHEE II method. For each individual result, the analyst calculates the intensity of preference for one alternative over anotherfor each criterion and for each pair of alternatives; followed by the preference index for each pair of alternatives; and then, the positive and negative flows (Brans and Macharis in Figueiras et al.,2005).

Finally, the net flow is calculated using the positive and the negative flow foreach alternative (Brans and Macharis, in Figueiras et al.,2005), which indicates the overall performance of each alternative according to the decision maker's preference. Based on the net flow information, the rankings of each decision maker are obtained, and the alternatives are ordered in decreasing order of their net flows.

When using the *closeness values* as inputs in the evaluation table, the ranking of alternative preferences shows the degree of overlap between the priorities of each stakeholder or group of stakeholders in respect to the IUCN categories.

2.4. Agregation of individual preferences

When integrating multiple stakeholders in the process, Multi-criteria techniques have to use also mathematical techniques or participation techniques to integrate all preferences. The same PROMETHEE tools used in the individual stakeholder analysis are available to the decision-maker.

The global net flow Φ_G is calculated as a weighted average of the individual net flows:

$$\Phi_G(a_i)=\sum_{s=1}^{S}\sum_{j=1}^{k}\Phi_{s,j}(a_i)\omega_s, \quad i=1,2,\ldots,n,$$

Where ω_s represents the relative importance of stakeholder *s*.

The importance of each stakeholder in the process is determined using the weights for each stakeholder or groups of stakeholders.

2.5. Evaluation of the conjoint results and resolution of conflicts.

The evaluation of the results is based on three analyses: analysis of the dispersion of individual results for each alternative, consistency analysis of the global result and comparative analysis of the results of the staff of the protected area with the overall result.

Dispersion analysis: the use of a measure of dispersion of individual rankings for each alternative can provide an approximation of the alternatives with higher discrepancies. The variance can be a useful and simple indicator to identify potential conflicts for each alternative. These results can provide guidance to decision-makers to assign weights to the stakeholders and assess the effect on the joint result. This information can be helpful to the management authority of the protected area to identify specific problems and plan communication channels and participatory processes with the affected stakeholders.

Consistency analysis: To validate the consistency of the overall result a sensitivity analysis on the weights for each stakeholder group can be performed, to evaluate their joint effect. In this way the acceptance ranges for each alternative can be approximated.

Expert analysis: The results of the staff of the protected area should be analyzed thoroughly and compared with the overall result. This group consists of experts who know the problems the park in depth, but furthermore are managers and usually decision makers. When incorporating the preferences of stakeholders in decision-making strong discrepancies may appear between the results of stakeholder and those of the experts. This may be because the interest of some stakeholders are opposed to the conservation aims. On the other hand, sometimes the stakeholders do not have the knowledge, training and information needed to evaluate macro-management issues. For this reason, the expert evaluations should serve as a reference throughout the process of decision-making and should be compared with the overall results. This analysis can complement the analysis of the dispersion of individual results in order to detect conflicts of interest.

Conflict Resolution: the generality of this model does not allow to define methods for conflict resolution. Conflict resolution must be approached differently for each protected area, depending on its context and problematic. However, the information generated by the proposed methodology for the evaluation of the results makes possible to identify management objectives where major discrepancies occur and also the stakeholder groups where major conflicts can arise. This information can be used to enhance communication channels with all relevant actors and develop collaborative mechanisms that provide a space for dialogue and search for solutions to specific problems.

3.APPLICATION

3.1.Study area

Protected natural areas in the Valencian Community are classified into seven categories: Natural Parks, Natural Areas, Municipal Natural Areas, Nature Reserves, Natural Monuments, Special Importance Places and Protected Landscapes. The protection category assignment is performed according to the natural and biological resources and values contained in each area (Ley 11/94 de Espacios Naturales de la Comunidad Valenciana).

The Albufera Natural Park is a protected coastal wetland in Valencia. It was declared a Natural Park in 1986 and included in the Ramsar list of wetlands of international importance in 1991, which recognizes it as a special protection area (SPA). It covers an area of 21120 ha, two thirds of which are devoted to rice cultivation and distributed in small parcels of private property. Anthropic pressure in the last century has been very intense. Furthermore, the use of agriculture, fishing and hunting or general public use have caused conflicts between agents with different interests. Figure 1 presents a map of the Natural Park of Albufera of Valencia and the included municipalities.

Figure 1. Map of Albufera de Valencia Natural Park with municipies inclused (Source: Generalitat Valenciana, 2011).

Management structure and Authorities

The management of Nature Reserve Network in the Valencian Community is characterized by complex rules and generally includes various public administration. This often entails communication problems between the different actors involved in the management, and between them and other stakeholders related to the park.

On the other hand, a distinction between decision-makers and participants has to be done. The management structure of the Network of Natural Parks of Valencia consists of a management authority of public and regional level, the “Conselleria d’Infraestructuras,Territori i Medi Ambient”, belonging to the “Generalitat Valenciana” and by a board of representation of stakeholders, called “Junta Rectora”.

This board consists of representatives of all the agents connected to the protected area. The decision-making body of the Albufera Natural Park is the “Consejo Directivo”, consisting of the Director of the Natural Park and of representatives of regional and local public administration (Segarra and Dies, 2011). This authority has the right to make decisions while the “Junta Rectora” is only advisory, so that can participate in the process but has no ability to make decisions.

3.2. Stakeholders, survey design and data collection

The selection of stakeholders in this study was not part of the research design, however it has been paid attention to incorporate representative stakeholders, who mostly belong to the governing board of the park. Fifteen stakeholders were interviewed and included in four groups: Conservationist, Government, Owners and Staff. Two stakeholders belong to the *Conservationist* group and are members of environmentalist associations. *Government* is made up of four representatives of municipalities. *Owners* consists of three representatives of land owner associations. *Staff* consists of four park technicians and the major manager.

In order to collect the stakeholders assessments on the importance of management objectives a Likert survey has been designed with four evaluation options: Zero, Low, Medium and High. A pilot trial has been made with a first survey that was sent to seven experts in management of natural areas from university and government. As a result of this pilot trial the formulation of two items has been changed. The final survey was distributed to stakeholders on-line and through personal interviews.

3.3. Characterization of the decision problem

The aim: The goal of the decision problem is to identify the international category of protection equivalent to the Albufera Natural Park on the basis of the management objectives priorities of a protected area.

The criteria: The criteria are predetermined and are the management objectives of protected areas within the IUCN framework: these criteria correspond to the main management objectives in the protection categories allocation system of the IUCN: Scientific Research, Protection of Wilderness, Biodiversity Preservation, Education, Tourism, Protection of natural resources and cultural resources, Ecosystem services, Sustainable Use and Cultural Values and Traditions (Table 1).

The alternatives: also alternatives are predetermined and are the protection categories of the World Network of Protected Areas: Ia, Ib, II, III, IV, V and VI (Table 2).

Preference Functions: Preference Functions have been identified for all criteria.

Closeness values: The inputs of the evaluation grid are the closeness values. For its calculation we followed the following steps: first, the survey results have been prepared. High titers were punctuated with priority 1, tights with priority 2, low with priority 3, and the null with priority 0. The priorities of management objectives for stakeholders are shown in Table 4. Afterwords, deviations were calculated in absolute value among the priorities for each stakeholder and priorities for the IUCN. Finally, we have reversed the values in order to give the more higher points to the similarity.

Stakeholder	RESEARCH	PRISTINES AREAS	BIODIVERSITY	ECOSYSTEM SERVICES	STRICT CONSERVATION	TOURISM	EDUCATION	SUSTAINABLE USE	SOCIAL VALUES
STK 1-C	1	1	1	2	2	2	1	1	2
STK 2-C	1	1	1	2	2	2	1	1	2
STK 3-G	1	1	1	1	1	1	1	1	1
STK 4-G	1	1	1	1	1	1	1	1	1
STK 5-G	1	1	1	1	1	1	1	1	1
STK 6-G	3	2	1	2	2	2	3	3	2
STK 7-S	1	1	2	1	1	1	1	1	1
STK 8-S	2	1	1	1	2	2	1	2	2
STK 9-S	1	1	1	1	2	2	2	1	2
STK 10-S	3	1	1	2	1	2	1	3	2
STK 11-S	2	1	1	2	2	2	2	2	2
STK 12-S	1	1	1	2	1	2	1	1	1
STK 13-O	2	2	2	2	2	3	2	2	2
STK 14-O	2	2	2	2	2	3	2	2	2
STK 15-O	1	1	2	2	3	2	2	2	2

Conservationists	Government	Staff	Owners

Table 4– Priorities for Management Objectives in Albufera Natural Park

Stakeholders Weights: in order to obtain the global net flows the same weight for all stakeholders has been assigned, so that:

$w_1, w_2, \ldots, w_{15} = 6{,}7\ \%$.

3.4. Evaluation stage and results

Individual Ranks

The information collected from stakeholder measured by closeness values and the remaining parameters considered by the analyst (preference functions and threshold parameters) were combined through the PROMETHEE II method to obtain the individual rankings. Table 5 shows the individual results for the fifteen stakeholders. The category V (Protected Lanscape / Seascape) obtained the highest number of top positions in the individual results, obtaining score "1" for eleven times. This result shows a clear preference for the stakeholders of the Albufera of Valencia towards this protection category of protection. On the other hand, the highest number of the worse individual positions are in the category Ia (Strict Nature Reserve) with six scores, and in category VI (protected areas with Sustainable Use of Natural Resources) with five scores.

Alternatives	STK1	STK2	STK3	STK4	STK5	STK6	STK7	STK8	STK9	STK10	STK11	STK12	STK13	STK14	STK15	VAR
Ia	7	7	4	3	3	3	6	3	3	7	6	7	2	7	7	4,00
Ib	5	6	2	5	5	5	5	7	7	5	1	6	5	6	6	2,64
II	1	2	3	2	2	2	4	4	4	2	3	2	3	3	3	0,81
III	6	5	5	4	4	4	7	6	6	6	7	5	4	5	5	1,07
IV	2	3	6	6	6	6	2	5	5	4	5	3	6	2	2	2,89
V	3	4	1	1	1	1	1	1	1	3	2	1	1	1	1	0,98
VI	4	1	7	7	7	7	3	2	2	1	4	4	7	4	4	5,07

Table 5. Individual Ranking with variance.

Global rank and evaluation of conjoin results

Global Rank: PROMETHEE II aggregate individual results using a weighted arithmetic mean. Thus, the single results were aggregated to create the global result. The global ranking is shown and net flow for each alternative can be seen in table 6.

Alternative	Rank	Net Flow
Ia	7	-0,13
Ib	5	-0,09
II	2	0,12
III	6	-0,1
IV	4	-0,02
V	1	0,22
VI	3	0,01

Table 6. Global Net Flow and Rank

Figure 2 show global results, which show a clear preference for the category V (Protected Landscape / Seascape). Global result show the same structure that individual results. Category V (Protected Landscape/Seascape) is placed first in eleven individual rankings. The Second place in the global ranking is occupied by Category II-Parque Nacional, which appears six times in that position in the individual rankings. Category Ia (Strict Nature Reserve) is the last in global and individual results. This brief analysis indicates that the global ranking is consistent with the individual ones, which means that the aggregation of individual results was satisfactory.

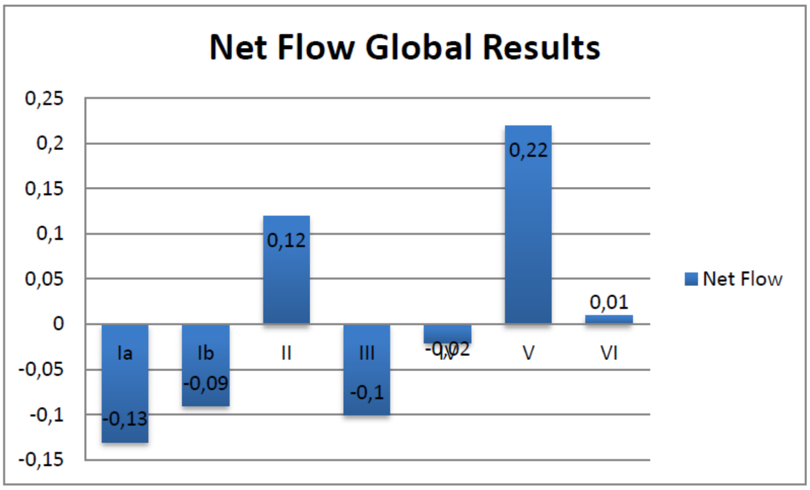


Figure 2-Global Net Flow by Protection Categories

Dispersion Analysis: The variance of each alternative provides an estimate of the degree of discrepancy. Alternatives VI (PAS with Sustainable Use of Natural Resources) and Ia (Strict Nature Reserve) show the largest variance (table 5). This suggests that although in the overall ranking they have obtained the worst positions, some stakeholders consider these adequate protection categories. In these cases the results should be analyzed by stakeholder group to identify deviations and evaluate the effect on the joint results. The consistency of the overall ranking can be validated by analyzing variations in the global ranking when the weights of the stakeholders are modified.

If the results are grouped by stakeholder (figure 3) the preferred category for all stakeholders but Government is the category V.

The scatter in the results of the alternative Ia is caused by the Owners group evaluation, which considers this alternative not suitable for Albufera, with a net flow of -0.33 compared to a net flows for Conservationist of + 0.06. These results agree with expectations, since the alternative Ia prioritizes scientific research objectives and biodiversity conservation and does not considere aims related to the use of resources such as sustainable use, tourism, education or maintenance of natural or cultural attributes. Furthermore, the discrepancies on alternative VI occur between Owners (NF +0.10) and Government (NF -0.04) and Staff (NF-0, 02).

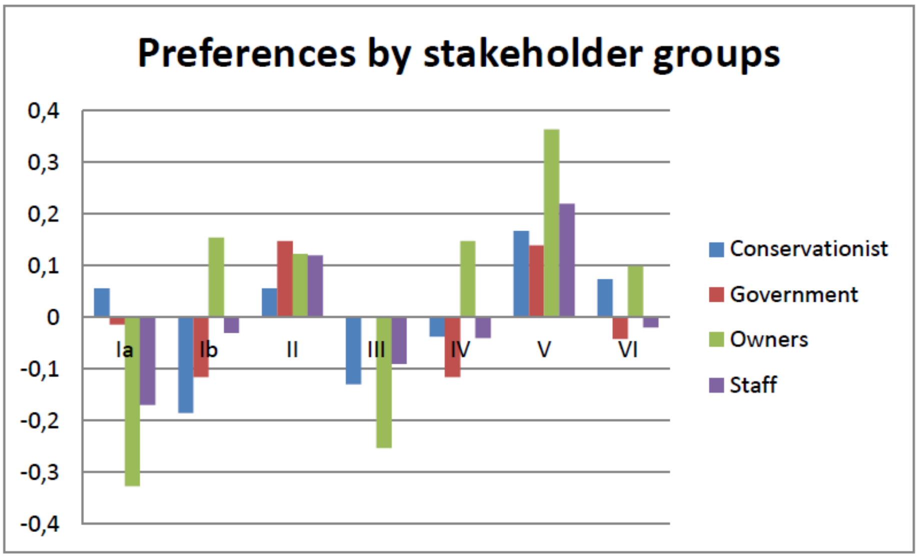


Figure 3-Preferences by stakeholder groups

Consistency Analysis: Furtherer, a sensitivity analysis was performed to evaluate the behavior of the results if the representatives of government had assigned a higher priority to the criterion which evaluates the category II. This specific analysis is not related with the conflict resolution state, since it was assumed that all decision makers agreed on final result and this stage was suppressed.

An increase was provoked in the weights assigned by the government representatives (STK4, STK5, STK6 and STK10) to 70 % in the conjoint of the stakeholders; ie 17.5 % by each government stakeholder and 2.7 % by all rest stakeholders and the global ranking was not changed, emphasizing the strength of the other representatives in constructing the final decision. Finally we used equal weights for stakeholders groups and we obtained the same global rank, except positions 5 and 7 to categories Ia and Ib.

Expert Analysis: Staff results coincide with the joint all alternatives except for Ib and IV categories, as shown in Table 8. The three best positioned alternatives in the global ranking coincide with those of the experts.

Alternative	Staff Rank	Global Rank	Staff Net Flow	Global Net Flow
Ia	7	7	-0,17	-0,13
Ib	4	5	-0,03	-0,09
II	2	2	0,12	0,12
III	6	6	-0,09	-0,1
IV	5	4	-0,04	-0,02
V	1	1	0,22	0,22
VI	3	3	-0,02	0,01

Table 7.Staff Rank and Net Flow

4.DISCUSSION AND CONCLUSIONS

The proposed model offers a Multi-criteria Decision Support for defining priorities in protected areas management and establish equivalences with international protection categories in a structured way.

The participation of stakeholders in defining management objectives of a protected area provides transparency to the design of public policies and helps to improve the governance of the area. Moreover it allows to identify the management targets that present the greater conflicts and the affected stakeholders. A measure of dispersion as the variances of the individual rankings can be a simple indicator to obtain a first approximation of the level of discrepancy between stakeholders for each alternative.

The assessments of the protected area staff should serve as a reference in the process as they are experts who know the problems of the area and to ensure that the essential purpose of nature conservation in the long term, is taken into account throughout the process of decision making. Often stakeholder interests are contrary to this objective and is impossible to achieve consensus solutions. In these cases, it is fundamental to establish clear, transparent and participatory communication channels, to enable joint solutions to specific problems.

One of the strengths of the proposed model is its generality, which allows its application to all protected areas in the WDPA, and also its simplicity to obtain data as it requires a very small amount of inputs. The information generated can provide support to develop specific management strategies for each protected area.

The application of the model in the Albufera Natural Park has identified the category V-Protected Lanscape / Seascape IUCN as the equivalent international protection category. The results obtained by the staff and other stakeholders have no major discrepancies. This suggests that in addition this protection category seems well adapted to the social context of this protected area. The category V prioritizes the protection of natural and cultural resources, tourism and maintenance of natural and cultural attributes. As second priority it considers scientific research purposes, conservation of biodiversity, conservation of ecosystem services, education and sustainable use of resources. This international protection category usually fits well to ecosystems strongly modified by human activties as is the case of the Albufera of Valencia.

This paper is a contribution to the development of comparable information systems in the worldwide network of protected areas and helps to improve the evaluation of their management, incorporating the principles of good governance.

It would be interesting to develop new research aimed at developing multi-criteria models for standardizing the large number of heterogeneous data available on the world's protected areas, generating comparable information: a necessary step to improve the management at the global network of protected areas.

REFERENCIAS

Abrams, P., Borrini-Feyerabend, G.,Gardner, J. and Heylings, P. 2003. Evaluating Governance. A Handbook to accompany a participatory process for a protected area. PARKS CANADA and TILCEPA—Theme on Indigenous and Local Communities, Equity and Protected Areas of IUCN CEESP /WCPA.

Ananda J. and Herath G. ,2009. A critical review of multi-criteria decision making methods with special reference to forest management and planning.Ecological Economics 68, 2535-2548

Belton, V. and Stewart,E.,2002. Multiple Criteria Decision Analysis. An Integrated Approach. Kluwer Academic Publishers

Behzadian,M.,Kazemzadeh,R.B.,Albadvi,A. and Aghdasi,M. 2010. PROMETHEE: A comprehensive literature review on methodologies and applications. European Journal of Operational Research 200: 198-215

Bouyssou, D.2000. Building criteria: a prerequisite for MCDA, in "*Readings in Multiple Criteria Decision-Aid*", C.A. Bana e Costa (ed.), pp. 58–80, Springer Verlag, Heidelberg, 1990

Brans ,J.P. and Mareschal,B.2005.PROMETHEE Methods, chapter 5 in Multiple Criteria Decision Analysis, State of the Art Surveys.Edited by Figueira,J;Greco,S. and Ehrgott,M. Springter. PP.163-195

De Brucker, K.,Macharis, C. And Verbeke, A.,2013. Multi-criteria analysis and the resolution of sustainable development dilemmas: A stakeholder management approach. European Journal of Operational Research 224: 122-131

Dudley, N.,Parrish,J.D.,Redford,K.H. and Stolton, S. 2010. The revised IUCN protected areas management categories: the debate and ways forward. Oryx 44: 485-490

Dudley, N. (Ed.) 2008. Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN .x+86 pp.

EUROPARC-España. 2008. Planificar para gestionar los espacios naturales protegidos. Ed. Fundación Interuniversitaria Fernando González Bernáldez para los espacios naturales. Madrid. 120 páginas

Figueira, J.,Greco,S. and Ehrgott, M. ,2005.Multiple Criteria Decision Analysis. State of the Survey.Ed. Springuer Science +Bussiness Media, Inc,2005

Fizsimons,F.,Pearson,C.J,Lawson,C. and Hill, M.J.2012. Evaluation of land-use planning in greenbelts based on intrinsic characteristics and stakeholder values. Landscape and Urban Planning 106: 23-34

Generalitat Valenciana, 1994-Ley 11/1994 de Espacios Naturales Protegidos.

Gregory , R. and Keeney,R.L., 1994.Creating Policy alternatives using stakeholders value .Management Science 40:1035-1048

Hockings M, Stolton S.Leverington,F .,Dudley N .and Cporrau,J.,2006. Evaluating effectiveness: a framework for assessing management effectiveness of protected areas IUCN Cardiff University best practice series no 14 IUCN Gland, Cambridge:IUCN

Kijazi, M.H. and Kant, S. 2011. Social acceptability of alternative forest regimes in Mount Kilimanjaro, Tanzania, using stakeholder attitudes as metrics of uncertainly. 2011. Forest Policy and Economics 13: 242-257

Leverington, F., Lemos Costa, K., Pavese, H., Lisle, A.and Hockings, M .2010. A Global Análisis of Protected Area Management Effectiveness. Environmental Management 46, 685-698

Lockwood,M., Worboys, G. and Kothari, A. ,2006. Managing Protected Areas. A global guide. Edited by Lockwood,M., Worboys, G. and Kothari, A.

Lockwood, M., 2010. Good governance for terrestrial protected areas: A framework, principles and performance outcomes. Journal of environmental management 91,754-766

López Ornat, A., and Pons ,A. and Noguera,M. 2007.Utilización de las categorías de gestión de áreas protegidas de UICN en la región mediterránea. Consejería de Medio Ambiente de la Junta de Andalucía, Sevilla, España y UICN, Gland, Suiza y Málaga, España. 211 pp.

Macharis,C., Springael,J.,de Brucker,K and Verbeke,A.,2004. PROMETHEE and AHP: The design of operational synergies in multicriteria analysis. Strenghtening PROMETHEE with ideas of AHP. European Journal of Operational Research 153: 307-317

Mendoza, G.A. and Martins, H.,2006. Multi-criteria decision analysis in natural resource management:A critical review of methods and new modelling paradigms. Forest Ecology and Management 230 : 1–22

Moffett,A. and Sarkar, S.,2006. Incorporating multiple criteria into the design of conservation area networks: a minireview with recommendations.Diversity and Distributions 12: 125-137

Mustajoki ,J.,Saarikoski, H., Marttunen, M., Ahtikoski, A., Hallikainen, V., Helle, T.,Hyppönen, M., Jokinen, M., Naskali, A.,Tuulentie, S.,Varmola, M.,, Vatanen, E. and Ylisirniö, A. ,2011.Use of decision analysis interviews to support the sustainable use of the forests in Finnish Upper Lapland. Journal of Environmental Management 92 : 1550-1563

Nordstrom, E., Eriksson, L.O. and Ohman, K.,2010. Integrating multiple criteria decision analysis in participatory forest planning: Experience from a case study in northern Sweden. Forest Policy and Economics 12: 562-574

Oikonomou,V.,Dimitrakopoulos, P.G. and Troumbis, A.Y.,2011. Incorporating Ecosystem Function Concept in Environmental Planning and Decision Making by Means of Multi-Criteria Evaluation: The Case-Study of Kalloni, Lesbos, Greece. Environmental Management 47:77-92

Pomerol, J.C. and Barba-Romero, S.,2000. Multicriterion Decision Management. Principles and Practice. Ed. Kluwer's International Series,2000

Prato,T.,2001. Modeling carrying capacity for national parks. Ecological Economics 39: 321-331

Proctor ,W and Dreschler, M. 2003. Deliberative Multi-criteria Evaluation: A case study of recreation and tourisme options in Victoria Australia. European Society for Ecological Economics, Febr.11-15,2003

Schmoldt, D.L. and Peterson, D.L.,2000. Analytical group decision making in natural resources: methodology and application. Forest Science 46: 62-75

Segarra, J. and Dies, B.,2011.Historia de la gestión del Parc Natural de l'Albufera (Valencia, España) en Los humedales mediterráneos: el contexto ambiental y social. Reflexiones para su estudio y gestión eficaz. Viñals, M.J., Blasco, D. and Morant, M. (eds).2011. Ed. Fundación Biodiversidad. 266 pp.

Stoll-Klemann,S. 2010. Evaluation of management effectiveness in protected areas: Methodologies and results. Basic and Applied Ecology 11: 377-382

Stolton,S.,Hockings,M.,Dudley,N.,Mackinnon,K., Whittwn, T. and Leverington, F.2007. Management Effectiveness Tracking Tool. WWF International, Gland.

UNEP/CBD/COP/11/11-COP- www.cbd.int access in march 2013

Weintraub, A.,Romero,C.,Bjorndal,T. and Epstein, R., 2007.Handbook of Operations Research in Natural Resources. Ed. Springer Science Bussiness Media LLC.,2007

Whitfield, S., Geist, H.J. and Loris, A.A.R. ,2011.Deliberative assessment in complex socioecological systems: recommendations for environmental assessment in drylands. Environmental Monitoring Assessment 183: 465-483

Zendehdel , K., Rademaker ,M., De Baets, B. and , Van Huylenbroeck, G. Environmental decision making with conflicting social groups: A case study of the Lar rangeland in Iran. Journal of Arid Environments 74: 394-402

DISCUSIÓN GENERAL

Cedral del Alto Atlas (Marruecos). Foto: V. Urios.

La interdisciplinariedad y la escala global son los rasgos que caracterizan el enfoque de esta tesis doctoral.

La interdisciplinariedad asegura la consideración de elementos de carácter conservacionista, pero también de carácter social, económico e institucional en los sistemas ecológicos y sociales. Incorporar la participación en las tomas de decisiones en áreas protegidas contribuye a gestionar sobre la base del buen gobierno y a mejorar la calidad de sus instituciones. Este es un primer paso que refuerza la función de estas instituciones en el gobierno de los comunes no sólo para “restringir” sino también para “incentivar” a la conservación.

La escala global permite identificar prioridades de conservación desde un enfoque ecoregional. Cuando la eficacia de la conservación de la biodiversidad se analiza desde una perspectiva internacional se pueden considerar los costes y los beneficios relativos. En un contexto con recursos limitados donde los costes relativos adquieren relevancia, resulta imprescindible priorizar la canalización de los fondos internacionales de conservación. Por otro lado la conservación de la biodiversidad se maneja actualmente a través de una gran cantidad estrategias que utilizan diversas metodologías y bases de datos y en ocasiones existe una gran cantidad de información disponible a nivel local y regional que muchas veces no es utilizable a nivel internacional e incluso nacional. La información generada por análisis globales puede ayudar a diseñar sistemas de áreas protegidas nacionales y regionales que representen los rasgos distintivos de cada área protegida y su contexto específico sobre una base común que proporcione solidez y comparabilidad, además de representatividad.

Este enfoque global permite definir prioridades de conservación y fortalecer la red mundial de áreas protegidas y contribuye a mejorar la planificación estratégica de su gestión.

Capítulo 1. Relacionando objetivos científicos y políticos para la conservación de la biodiversidad global: implicaciones para la expansión de la red mundial de áreas protegidas.

A pesar de la gran diversidad de criterios y medidas utilizadas para establecer prioridades globales de conservación y la enorme disparidad de regiones prioritarias para la acción global de conservación puestas de manifiesto por las organizaciones de conservación más importantes, es posible mejorar sustancialmente la conservación global de la biodiversidad simplemente haciendo cumplir los compromisos de conservación actuales. Como muestra este trabajo, esta sería una herramienta de conservación global costo-efectiva para ampliar la red de áreas protegidas del mundo.

En la planificación de la conservación no deben olvidarse las consideraciones económicas (Balmorfd et al.,2000,2003). En un contexto con recursos limitados, para la asignación adecuada de fondos internacionales (Wilson et al. 2006) es muy importante identificar adecuadamente las áreas prioritarias en las que invertir. De otra manera, si no se considera el coste relativo de invertir en diferentes regiones, se corre el riesgo de gastar recursos en regiones donde comparativamente se obtienen menores beneficios de conservación .

Para alcanzar el objetivo del CDB del 10% de representar todas las regiones ecológicas sería necesario proteger un 4.6 % más de la superficie terrestre. Lograr este objetivo en las 33 ecoregiones poco representadas supondría únicamente 2088 km^2 , esto podría resultar poco costoso. Con el mismo gasto anual, el área total que puede ser efectivamente conservada es mayor en áreas poco modificadas por el hombre y decrece con la densidad poblacional y el Producto Nacional Bruto (Balmford et al.,2003). De esta forma, parece que sería una forma eficiente de conservación global invertir fondos en las ecoregiones poco representadas en países en desarrollo en Asia, África, Norte de Eurasia, Este Medio y Latinoamérica.

Por otro lado, los objetivos de conservación de las 62 ecoregiones contempladas por los tres patrones de conservación deberían ser revisados con atención ya que quizás sería recomendable plantear objetivos de conservación más ambiciosos. Respecto a las 549 ecoregiones que no han alcanzado el objetivo del 10% no deberían olvidarse como candidatas importantes para planes de expansión menos urgentes.

Este es un análisis global que ofrece una orientación general sobre las regiones que requieren de manera prioritaria fondos para la conservación. El enfoque macro resulta necesario para visualizar los costes relativos de invertir en diferentes regiones y su costo-efectividad. Cuando no se consideran escalas internacionales esta perspectiva no se consigue y la asignación de recursos puede realizarse de manera poco eficiente, de modo que se podría alcanzar el objetivo del 10% del CDB incorporando a la red reservas con escaso valor de conservación. Sin embargo, esta debe ser una primera escala de trabajo que debe completarse con análisis regionales.

El 78% de las ecoregiones que se han identificado en este trabajo como prioritarias para la expansión de la red (como mínimo), lo son también para las principales estrategias de conservación internacionales. Canalizar los esfuerzos de conservación hacia las ecoregiones poco representadas, pero identificadas como prioritarias por las principales organizaciones de conservación puede contribuir al objetivo del CDB sin tener que modificar sus propios objetivos. Estas sinergias muestran que identificar y priorizar objetivos políticos y científicos comunes puede contribuir al fortalecimiento institucional de sistemas como la red de áreas protegidas del mundo y contribuir a su eficiencia en la conservación global de la biodiversidad.

Capítulo 2. Un marco de trabajo para el analizar la gobernanza de las áreas protegidas.

Las áreas protegidas son sistemas ecológicos y sociales (SESs) que tienen una serie de restricciones formales respecto del uso de sus recursos naturales y de las actividades que se pueden desarrollar en ellas. Estas restricciones formales suelen generar pérdidas de reciprocidad en el uso de los recursos por las comunidades locales ó agentes sociales (Ogra and Badola, 2008). Las interacciones entre agentes en SESs es complicada porque existe un gran número de agentes con intereses contrarios. Investigaciones en varias disciplinas han mostrado que algunas políticas gubernamentales han acelerado la destrucción de los recursos naturales, mientras que algunos usuarios de los recursos han invertido tiempo y energía para lograr la sostenibilidad (Ostrom, 2009).

Esto sugiere la importancia de la calidad institucional en las áreas protegidas en el gobierno de los comunes. Algunas teorías basadas en la nueva economía institucional como la teoría de la acción colectiva aportan elementos necesarios para definir el buen gobierno que se basan en la calidad institucional. Las instituciones para gestionar los recursos comunes deben ser eficientes en dos aspectos: restringir el acceso y generar incentivos para que los usuarios inviertan en los recursos en vez de sobre explotarlos (Ostrom,2009).

Aunque se han realizado verdaderos esfuerzos en integrar aspectos sociales en la gestión de las áreas protegidas, como la definición de los principios de buena gobernanza en áreas protegidas (Abrams et al.,2003; Graham et al.,2003; Lockwood, 2010) todavía no se han considerado algunos de los atributos que determinan la calidad institucional.

Este trabajo incorpora algunos de estos aspectos como la eficiencia institucional, la sostenibilidad institucional y la diversidad y la distancia institucional.

La eficiencia institucional representa la capacidad de las instituciones de generar los incentivos adecuados para crear estrategias de cooperación en los agentes y de resolver conflictos. Dicho de otro modo, de crear una "cultura de buen gobierno" donde los agentes comprenden y asumen como propios los objetivos del área protegida, se involucran en los procesos y tienen capacidad para organizarse. Además, la eficiencia institucional debe asegurar la reciprocidad, que se consigue cuando la distribución de los costes y beneficios del sistema se reparten de manera equitativa y justa entre todos los agentes (Ostrom, 2000).

La sostenibilidad institucional se refiere a la predictibilidad de los sistemas dinámicos (Ostrom,2009), es decir a la flexibilidad de las instituciones para adaptarse a los cambios pero también a su robustez, es decir a su capacidad de generar confianza en los agentes. Los sistemas dinámicos tienen que ser suficientemente predecibles para que los usuarios puedan estimar qué ocurriría si ellos establecerían algún tipo de norma ó restricción (Ostrom,2009). La eficiencia institucional y la sostenibilidad institucional son elementos basados en el largo plazo que contribuyen a generar confianza de los agentes hacia las instituciones.

Por último la diversidad institucional se refiere a la variedad de instituciones vinculadas a un área protegida y la distancia institucional a la existencia de instituciones de niveles superiores que garantizan elementos como la neutralidad, vigilancia, coordinación y comparabilidad y que pueden servir de referencia para los niveles regionales y nacionales.

La participación de las comunidades locales en la gestión de las áreas protegidas cada vez adquiere mayor importancia (Ostrom,1999; Dearden et al., 2005; Khotari,2008;Schultz and Duit, 2010; Conrad et al.,2011) pero son necesarios unos requisitos de calidad institucional para que la acción colectiva funcione (Ostrom,1990). Los principios de buen gobierno en áreas protegidas se han movido en la misma dirección y enfatizan atributos como la participación y la equidad y si consideramos las aportaciones de este trabajo, la capacidad para incentivar a los agentes a conservar sus recursos naturales.

Capítulo 3. Una revisión crítica de la toma de decisiones multi-criterio en áreas protegidas.

La evolución de técnicas de análisis multi-criterio en la toma de decisiones en áreas protegidas se ha caracterizado por tres rasgos destacados: uno, en los últimos años se presta más atención a "cómo gestionar" en detrimento de "dónde gestionar". Se han realizado más trabajos sobre conservación de especies, gestión y uso de los recursos. Sin embargo los problemas relacionados con el diseño de áreas protegidas parecen tener menor interés. Dos: un claro incremento de la participación en los procesos de toma de decisiones (Mendoza and Martins, 2006). Tres: existe un gap en el desarrollo de trabajos empíricos frente a un gran número de trabajos teóricos (Ananda and Herath, 2009)

El auge que los estudios sobre diseño de áreas protegidas tuvieron entre 2004 y 2008, que utilizaban fundamentalmente programación entera ó programación multi-objetivo combinadas con GIS (Arponen et al.,2004;Copeland et al.,2007; Moilanen,2007; Teeffelen et al.,2006; Wood and Dragicevic,2007) ha cedido protagonismo a una proliferación de trabajos sobre gestión y uso de los recursos (Arciniegas et al.,2011;Fitzimons et al.,2012; Kijazi and Kant,2011;Lennox et al.,2011;Mustajoki et al. ,2011;Oikonomou et al.,2011;Whitfield et al.,2011) . Sin embargo, la mayor parte de trabajos sobre gestión en áreas protegidas se han desarrollado en el Norte de Europa, Australia , Canadá y Estados Unidos. En ecosistemas mediterráneos no se han desarrollado prácticamente trabajos sobre análisis multi-criterio para la toma de decisiones sobre gestión en áreas protegidas (Pavlikakis and Tshrintzis,2003).

Además, estos trabajos muestran una tendencia creciente del empleo de técnicas de análisis multi-criterio en toma de decisiones colaborativa, incluyendo cada vez más las preferencias de los agentes sociales en la toma de decisiones. Recientes investigaciones han mostrado cómo el análisis multi-criterio en tomas de decisiones participativas han resultado un instrumento útil para incorporar las preferencias de los agentes en procesos de tomas de decisiones complejos como la resolución de problemas sobre desarrollo sostenible, como el diseño de planes de gestión forestal, en los que existen un gran número de agentes y fuertes conflictos de interés (Ananda and Herath,2009; de Brucker et al.,2013). Por un lado las técnicas de análisis multi-criterio resultan especialmente útiles para alcanzar acuerdos, al facilitar un marco estructurado para la discusión en los procesos de toma de decisiones. Por otro lado, las técnicas de participación en grupo, con un grado fuerte de colaboración, ofrecen más posibilidades de éxito a la hora de alcanzar el máximo consenso y recuperar la pérdida de reciprocidad generada en ocasiones en las áreas protegidas (Belton and Pictet, 1997; Schmoldt and Peterson, 2000; Hamalainen et al.,2001; Fu and Yang.,2012). La participación puede incluirse en el proceso de toma de decisiones en alguna o todas de sus etapas y con mayor o menor grado de colaboración (Belton and Stewart, 2002), sin embargo parece que la incorporación de la participación en las etapas tempranas del proceso de toma de decisiones ofrece mejores resultados en la reducción de conflictos (Nordstrom et al., 2010). Por otro lado, en la última década han proliferado los “Soft-Systems”, “Decision Analysis Interviews” (DAIs) y “Procesos Deliberativos” en procesos de toma de decisiones en áreas protegidas (Mendoza and Martins, 2006; Marttunen and Hamalainen,2008; Mustajoki et al.,2011). Estos métodos se han utilizado fundamentalmente para resolver problemas relacionados con la gestión del agua (Lennox et al.,2011) y recientemente con problemas sobre control de especies invasoras (Lange et al.,2012) y aunque han ofrecido resultados positivos en la reducción de conflictos, en general resultan poco operativos debido a la gran cantidad de recursos y de tiempo que requieren. El empleo del análisis multi-criterio en toma de decisiones colaborativa ofrece importantes ventajas para el diseño de políticas públicas; generan conocimiento sobre el problema y sobre los objetivos de los diferentes agentes sociales, y aportan transparencia, equidad y comprensibilidad al proceso de toma de decisiones (Gregory and Keeney,1994; Nordstrom et al.,2010). No obstante, un grado de participación intermedio donde se incorporen los intereses de todos los agentes de manera adecuada desde las primeras etapas del proceso puede resultar adecuado para acercar posturas enfrentadas en la toma de decisiones.

Por último, conviene destacar la necesidad de desarrollar trabajos de carácter empírico que aporten herramientas útiles para la toma de decisiones en áreas protegidas utilizando técnicas de análisis multi-criterio para la toma de decisiones adecuadas y que permitan involucrar a todos los interesados en la toma de decisiones a nivel estratégico y táctico. Los ecosistemas mediterráneos y tropicales, con un elevado valor ecológico y una fuerte conflictividad entre los agentes sociales resultan candidatos prioritarios donde el empleo de técnicas multi-criterio en toma de decisiones colaborativa pueden ser útiles para definir planes de gestión eficientes y para asegurar el buen gobierno en las áreas protegidas.

Capítulo 4. Identificando equivalencias con las categorías internacionales de áreas protegidas usando análisis multi-criterio en tomas de decisiones colaborativas

El análisis multi-criterio puede resultar útil para incorporar las preferencias de los stakeholders en los procesos de toma de decisiones en áreas protegidas de una manera estructurada (Ananda and Herath,2003; Furstenau et al.,2997; Fitzimons et al., 2012; De Brucker et al.,2013).

Un modelo multi-criterio de ayuda a la toma de decisiones puede ser útil para resolver problemas de gestión estratégica en áreas protegidas, como definir objetivos prioritarios de gestión en áreas protegidas y establecer equivalencias con las categorías de protección internacionales de una manera estructurada. Por otro lado, la participación de los agentes sociales en la definición de los objetivos de gestión de un área protegida aporta transparencia al diseño de políticas públicas (Nordstrom et al., 2010) y contribuye a mejorar el buen gobierno del espacio protegido (Graham et al.,2003; Lockwood, 2010). Además, los objetivos de gestión que presentan mayores conflictos y los agentes afectados pueden identificarse usando las varianzas de los rankings individuales como un indicador de discrepancia entre agentes para cada alternativa.

Las evaluaciones del staff del área protegida deben servir de referencia en el proceso ya que son expertos que conocen la problemática del espacio natural y para garantizar que el objetivo esencial de conservación de la naturaleza a largo plazo se tiene presente a lo largo del proceso de toma de decisiones. Muchas veces los intereses de los agentes son contrarios a este objetivo y no es posible alcanzar soluciones consensuadas. En estos casos, resulta fundamental establecer canales de comunicación claros, transparentes y participativos que permitan encontrar soluciones conjuntas a problemas específicos.

Una de las fortalezas del modelo propuesto es su generalidad, que permite su aplicación a todos los espacios protegidos de WDPA, y la sencillez para obtener datos ya que requiere una cantidad de inputs muy reducida. La información generada puede servir de soporte para desarrollar estrategias de gestión específicas para cada área protegida.

La aplicación del modelo propuesto en el Parque Natural de la Albufera de Valencia ha permitido identificar la categoría V- Protected Lanscape/Seascape de IUCN como categoría de protección internacional equivalente. Los resultados obtenidos por el staff y el resto de agentes no presentan discrepancias importantes. Esto sugiere que además, esta categoría de protección parece adaptarse bien al contexto social del espacio protegido. La categoría V prioriza la protección de los recursos naturales y culturales, el turismo y el mantenimiento de atributos naturales y culturales. Con segunda prioridad considera objetivos de investigación científica, conservación de la biodiversidad, conservación de los servicios ambientales, la educación y el uso sostenible de los recursos. Esta categoría de protección internacional suele adaptarse bien a ecosistemas muy antropizados como en el caso de la Albufera de Valencia.

Este trabajo constituye una aportación para el desarrollo de sistemas de información comparables en la red de espacios protegidos del mundo y contribuye a mejorar la evaluación de su gestión incorporando los principios de buena gobernanza.

Sería interesante desarrollar nuevas investigaciones orientadas al desarrollo de modelos multi-criterio que permitan estandarizar la gran cantidad de datos heterogéneos disponibles en las áreas protegidas del mundo, generando información comparable: un paso necesario para mejorar la gestión de la red mundial de áreas protegidas.

CONCLUSIONES GENERALES

Cedral del Rif (Marruecos). Foto: V. Urios.

1. El objetivo del 10% de protección de la superficie terrestre suscrito en el Convenio de Diversidad Biológica actualmente no se cumple a nivel de ecoregión.
2. La superficie terrestre protegida necesaria para alcanzar el objetivo del Convenio de Diversidad Biológica es al menos, un 4.6% de la superficie de la Tierra para todas las categorías de protección contempladas en la IUCN.
3. La superficie terrestre protegida necesaria para alcanzar el objetivo del Convenio de Diversidad Biológica es, al menos, un 6.3% de la superficie de la Tierra para las categorías de protección I-IV contempladas en la IUCN.
4. Las ecorregiones prioritarias para el 78% de las estrategias internacionales de conservación son 62. De estas, en 33 no se ha alcanzado el objetivo del Convenio de Diversidad Biológica. Estas 33 ecorregiones son: ecosistemas costeros de la Península Arábiga y estribaciones de la savana del Suroeste arábigo, bosques húmedos de tierras bajas de Borneo, bosques húmedos de Mizoram-Manipur-Kachin, bosques subtropicales del Norte de Indochina, bosques subtropicales del Triángulo del Norte, bosques secos de Indochina Central, bosques de pino del Noreste de India-Myanmar, bosques caducifolios del Este del Himalaya, bosques templados del Triángulo Norte, savana y prados de Terai-Duar, manglares de Sunda Shelf, bosques de pino y roble de la Sierra Madre Occidental, bosques de pino y roble de la Sierra Madre Oriental,bosques montanos de Magdalena Valley, bosques atlánticos de Alta Paraná, Yungas Peruvianas, bosques secos del Atlántico, bosques secos de Jalisco, bosques secos de Marañon, bosques secos de Sinaloan, bosques secos del Sur de Pacífico, bosques de pino y roble de América Central, bosques de pino y roble de Sierra Madre del Sur, Cerrado, páramos de la Cordillera Central, matorral chileno, bosques de coníferas subalpinas de las montañas de Hengduan , bosques de coníferas alpinos de Nujiang Langcang Gorge, estepas de montaña y praderas de Tian Shan y bosques mediterráneos de acacia-argania del Mediterráneo .

5. La ampliación de la Red Mundial de Áreas Protegidas priorizando estas 33 regiones supondrá una estrategia eficiente en términos de costes de planificación de la conservación.
6. El análisis multi-criterio es una herramienta útil para incluir la participación de los agentes sociales en los procesos de toma de decisiones y mejorar la gobernabilidad de las áreas protegidas.
7. Las técnicas de análisis multi-criterio discretas que incorporan las preferencias de los agentes sociales son las más adecuadas para resolver problemas sobre gestión y uso de la tierra en áreas protegidas.
8. PROMETHEE es una técnica de análisis multi-criterio que puede mejorar la gestión de la red de áreas protegidas con un número reducido de datos.

REFERENCIAS GENERALES

Parque Natural de Cuyabeno. Río Aguarico (Ecuador). Foto: V. Urios.

Abrams, P., Borrini-Feyerabend, G.,Gardner, J. and Heylings, P. ,2003.Evaluating Governance. A Handbook to accompany a participatory process for a protected area. PARKS CANADA and TILCEPA—Theme on Indigenous and Local Communities, Equity and Protected Areas of IUCN CEESP /WCPA.

Ananda, J.,2007. Implementing Participatory Decision Making in Forest Planning Environ Management 39:534-544.

Ananda, J. and , Herath, G.,2003. Incorporating stakeholder values into regional forest planning: a value function approach. Ecological Economics 45 : 75-90.

Ananda, J. and , Herath, G.,2009. A critical review of multi-criteria decision making methods with special reference to forest management and planning. Ecological Economics 68: 2535–2548.Anderies, J.; Jassen, M.A. and Ostrom, E.,2004. A Framework to Analize the Robustness of Social-ecological Systems from an Institutional Perspective. Ecology and Society 1: 18.

Arciniegas, G., Janssen, R. and Omtzig, N. 2011. Map-based multicriteria analysis to support interactive land use allocation. International Journal of Geographic Information Science V.25 n.12 pp.1931-1947.

Arponen, A.,Heikkinen,R.K.,Thomas,C.D. and Moilanen,A. 2004. The Value of Biodiversity in Reserve Selection: Representation, Species Weighting, and Benefit Functions. Conservation Biology 19: 2009-2014.

Balmford. A., Bruner, A., Cooper, P., Costanza, R., Farber, S., Green, R.E., Jenkins, M., Jefferiss, P., Jessamy, V., Madden, J., Munro, K., Myers, N., Naeem, S., Paavola, J., Rayment, M.,Rosendo, S., Roughgarden, J., Trumper, K. and Turner, R.K.2002. Economic reasons for conserving wild nature. Science, 297: 950–953.

Balmford, A., Gaston, K.J., Blyth, S., James, A. and Kapos, V.2003. Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. Proceedings of the National Academy of Sciences USA, 100: 1046–1050.

Balmford, A., Bennun, L., ten Brink, B., Cooper, D., Cote, I.M.,Crane, P., Dobson, A., Dudley, N., Dutton, I., Green, R.E.,Gregory, R.D., Harrison, J., Kennedy, E.T., Kremen, C.,Leader-Williams, N., Lovejoy, T.E., Mace, G., May, R.,Mayaux, P., Morling, P., Phillips, J., Redford, K., Ricketts, T.H.,Rodriguez, J.P., Sanjayan, M., Schei, P.J., van Jaarsveld, A.S. and Walther, B.A.,2005.The convention on biological diversity's 2010 target. Science, 307, 212–213.

Bana e Costa,C.and Vasnick,J.C.2008. A critical analysis of the eigenvalue method use to derive priorities in AHP. European Journal of Operational Research 187: 1422-1428.

Belton ,V.and Pictet, J.,1997.A framework for group decision using a MCDA model: sharing, aggregating, or comparing individual information?. Journal of Decision Systems 6: 283-303.

Belton, V., and Stewart,T.S.,2002. Multiple Criteria Decision Analysis. An Integrated Approach. Kluwer Academia Publishers, Massachussets.

Behzadian,M.,Kazemzadeh,R.B.,Albadvi,A. and Aghdasi,M. 2010. PROMETHEE: A comprehensive literature review on methodologies and applications. European Journal of Operational Research 200: 198-215.

Brooks, T.M., Bakarr, M.I., Boucher, T., da Fonseca, G.A.B.,Hilton-Taylor, C.,Hoekstra, J.M., Moritz, T., Olivieri, S.,Parrish, J., Pressey, R.L., Rodrigues, A.S.L., Sechrest, W.,Stattersfield, A., Strahm, W. and Stuart, S.N.,2004. Coverage

provided by the global protected-area system: is it enough? Bioscience, 54:1081–1091.

Conservation International,2005. Biodiversity hotspots (http://www.biodiversityhotspots.org/xp/Hotspots, Accessed on 18

October 2005).

Brooks, T.M., Mittermeier, R.A., da Fonseca, G.A.B., Gerlach, J.,Hoffmann, M.,Lamoreux, J.F., Mittermeier, C.G., Pilgrim, J.D.and Rodrigues, A.S.L. 2006. Global biodiversity conservation priorities. Science, 313:58–61.

Chape, S., Harrison, J., Spalding, M. and Lysenko, I.,2005.Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. Philosophical Transactions of the Royal Society of London Series B, Biological

Sciences, 360: 443–455.

CIESIN, 2006. www.sedac.ciesin.columbia.edu Acessed in November 2007.

Conrad, E., Christie, M and Fazey, I.,2011. Is research keeping up with changes in landscape policy? A review of the literature. Journal of Environmental Management 92 ,2097-2108.

Copeland,H.E.,Ward,J.M. and Kiesecker, J.M.2007. Assessing tradeoffs in biodiversity, vulnerability and cost when prioritizing conservation sites. Journal of Conservation Planning 3: 1-16.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M.,Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J.,Raskin, R.G., Sutton, P. and van den Belt, M.,1997. The value of the world's ecosystem services and capital value. Nature, 387:

253–260.

Costanza, R. B.S., Low, E., Ostrom, E. and J.Wilson, editors. 2001 Institutions, ecosystems and sustainability. Lewis Publisher, New York, USA.

Cowling, R.M., Knight, A.T., Faith, D.P., Ferrier, S., Lombard,A.T., Driver, A., Rouget, M., Maze, K. and Desmet, P.G.,2004.Nature conservation requires more than a passion for species.Conservation Biology, 18: 1674–1676.

De Brucker,K.,Macharis,C. and Verbeke,A.2013. Multi-criteria analysis and the resolution of sustainable development dilemmas: A stakeholder management approach. European Journal of operational Research 224: 122-131.

Dearden, P.,Bennett,M. and Johnston, J. 2005.Trends in Global Protected Area Governance, 1992-2002. Environmental Management 36 : 89-100.

Diaz-Balteiro, L and Romero, C. 2008. Making forestry decisions with multiple criteria: A review and an assessment. Forest Ecology and Management 255 : 3222–3241.

Dudley, N. (Editor) .,2008. Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN. x + 86pp.

Dudley,N.,Parrish,J.D.,Redford,K.H. and Stolton,S.2010. The revised IUCN protected area management categories: the debate and ways forward. Oryx 44: 485-490.

Durbach., I.N. and Stewart, T.J. 2012.Modeling uncertainly in multiple-criteria decision analysis. European Journal of Operational Research 223:1-14.

Fernández ,G. and Escribano, M.C. 2013. After the steps of Decision Analysis: from its origins until the present days. Boletín de Estadística e Investigación Operativa 29: 55-77.

Figueira, J.,Greco,S. and Ehrgott, M. 2005. Multiple Criteria Decision Analysis. State of the Survey.Ed. Springuer Science Bussiness Media, Inc.2005.

Fizsimons,F.,Pearson,C.J,Lawson,C. and Hill, M.J.2012. Evaluation of land-use planning in greenbelts based on intrinsic characteristics and stakeholder values. Landscape and Urban Planning 106: 23-34.

Fu, Ch. And Yang,S.2012. An evidential reasoning based consensus model for multiple attribute group decision analysis problems with interval-valued group consensus requeriments. European Journal of Operational Research 223: 167-176.

Fuller,D.O., Meijaard,E.M.,Christy, L. and Jessup, T.C., 2010. Spatial assessment of threats to biodiversity within East Kalimantan, Indonesia. Applied Geography 30: 416-425.

Furstenau,C.,Badeck, F.W.,Lasch,P.,Lexer, M.J.,Lindner,M.,Mohr,P. and Suckow,F. 2007.Multiple-use forest management in consideration of climate change and the interests of stakeholder groups. European Journal of Forest Resources 126:225-239.

Garcimartín,C. and Alonso,J.A. 2008. Acción colectiva y desarrollo. El papel de las instituciones. Editorial Complutense SA.

Gibson,C.C., Ostrom,E. and Ahn, T.K.2000.The concept of scale and the human dimensions of global change: a survey. Ecological Economics 32:217-239.

Graham, J, Amos, B and Plumptre, T.,2003.Governance Principles for Protected Areas in the 21st. Century. Fifth World Parks Congress, South Africa in September 2003.

Gregory , R. and Keeney,R.L., 1994.Creating Policy alternatives using stakeholders value .Management Science 40:1035-1048.

GVA, 2011. Memoria de gestión 2011 Parque Natural de la Serra d’Espadà.

Hajkowicz,S.2008. Supporting multi-stakeholder environmental decisions. Journal of Environmental Management 88 : 607–614.

Hamalainen, R.P., Kettunen, E. and Ehtamo, H.2001. Evaluating a Framework for Multi-Stakeholder Decision Support in Water Resources Management. Group Decision and Negotiation 10:331-353.

Hardin,G. 1968.The Tragedy of the Commons. Science 162: 1243-1248.

Heritage Foundation, 2011. www.heritage.org/index Accessed on November 2011.

Hiltunenen,V.,Kurttila,M.,Leskinen,P.,Pasanen,K. and Pykalainen, J.2009. Mesta: An internet-based decision-support application for participatory strategic-level natural resources planning. Forest Policy and Economics 11:1-9.

Hoekstra, J.M., Boucher, T.M., Ricketts, T.H. and Roberts, C.,2005.Confronting a biome crisis: global disparities of habitat loss and protection. Ecology Letters, 8:23–29.

Hulme, D and Scott, J. ,2010. BWPI Annual Report.

Hunter, J.M.L. and Hutchinson, A.,1994. The virtues and shortcomings of parochialism: conserving species that are locally rare but globally common. Conservation Biology, 8: 1163–1165.

IIED ,2012. http://www.iied.org/governance/home Accesed in january 2012.

IUCN and UNEP-WCMC, 2011. Acceso en abril 2012 http://www.wdpa.org/Statistics.aspx

Janssen,M.A. and Anderies,J.M.,2007. Robustness Trade-offs in Social-Ecological Systems. International Journal of the Commons 1:43-65.

Kijazi, M.H. and Kant, S. 2011. Social acceptability of alternative forest regimes in Mount Kilimanjaro, Tanzania, using stakeholder attitudes as metrics of uncertainly. 2011. Forest Policy and Economics 13: 242-257.

Korhonen, P.,Moskowitz, H.,Wallenius, J.1992. Multiple criteria decision support. A review.European Journal Research 63:361-375.

Kothari , A., 2008. People and Parks. Parks 17: Nº 2 Durban +5.

Lange de,W.J., Stafford, W.H.L., Forsyth, G.G. and Maitre Le, D.C.,2012 Incorporating stakeholders preferences in the selection of technologies for using invasive alien plants as a bio-energy feedstock: Applying the analytical hierarchy process. Journal of Environmental Management 99: 76-83.

Lara, B. 1991. La Decisión, un problema contemporáneo. Espasa Universidad. Madrid.

Lennox,J.,Proctor,W.and Russell,S. 2011. Structuring stakeholder participation in New Zealand's water resource governance. Ecological Economics 70: 1381-1394.

Liu,J.,Linderman,M.Ouyang,Z.,An,L.,Yang,J. and Zhang,H.2001. Ecological degradation in protected areas: The case of Wolong Nature Reserve for Giant Pandas. Science,292: 98-101.

Lockwood, M., 2010. Good governance for terrestrial protected areas: A framework,

principles and performance outcomes. Journal of environmental management 91, 754-766.

Macharis,C., Springael,J.,de Brucker,K and Verbeke,A.,2004. PROMETHEE and AHP: The design of operational synergies in multicriteria analysis. Strenghtening PROMETHEE with ideas of AHP. European Journal of Operational Research 153: 307-317.

Marchamalo, M and Romero, C. 2007. Participatory decision-making in land use planning:An application in Costa Rica. Ecological Economics 63: 740-748.

Margules, C.R. and Pressey, R.L.,2000.Systematic conservation planning. Nature, 405: 243–253.

Marshall, G., McNeill,J and Reeve, I.J.2011.Economics for accountability in community-based environmental governance. Working paper 2 from the project "Improving economic accountability when using descentralised, collaborative approaches to environmental decisions". Institute for Rural Futures. University of England,Armidale. June 2011.

Marttunen,M and Hamalainen,P.1995.Decision analysis interviews in environmental impactassessment. European Journal of Operational Research 87: 551-563.

Marttunen, M. and Hamalainen, P. 2008. The Decision Analysis Interview Approach in the Collaborative Management of a Large Regulated Water Course. Environmental Management 42: 1026-1042.

Mendoza, G.A. and Martins, H. 2006. Multi-criteria decision analysis in natural resource management:A critical review of methods and new modelling paradigms. Forest Ecology and Management 230 : 1–22.

Mittermeier, R.A., Robles-Gil, P., Hoffman, M., Pilgrim, J.,Brooks, T.M., Mittermeier, C.G., Lamoreux, J. and da Fonseca,G.A.B. ,2004. Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions. CEMEX, México.

Moilanen, A.2007. Landscape Zonation, benefit functions and target-based planning: Unifying reserve selection strategies. Biological Conservation 134:571-579.

Mustajoki ,J.,Saarikoski, H., Marttunen, M., Ahtikoski, A., Hallikainen, V., Helle, T.,Hyppönen, M., Jokinen, M., Naskali, A.,Tuulentie, S.,Varmola, M.,, Vatanen, E. and Ylisirniö, A., 2011. Use of decision analysis interviews to support the sustainable use of the forests in Finnish Upper Lapland. Journal of Environmental Management 92 : 1550-1563.

Naughton-Treves,L.,Holland,M.B. and Brandon, K.2005. The role of protected areas in conserving biodiversity and sustaining local livehoods. Annual Review of Environmental and Resources, 30:219-252.

Nordstrom, E., Eriksson, L.O. and Ohman, K.2010. Integrating multiple criteria decision analysis in participatory forest planning: Experience from a case study in northern Sweden. Forest Policy and Economics 12: 562-574.

Norgaard,R.B. 2008.Finding Hope in the Millenium Ecosystem Assessment. Conservation Biology 22, 862.

North,D.C.1994. Economic Performance through Time. American Economic Review 84: 359-368.

Noss, R.F. ,1990. Indicators for monitoring biodiversity: a hierarchical approach. Conservation Biology, 4: 355–364.

OCDE, 2012. www.oecd.org Acessed in January 2012.

Ogra, M and Badola, .R.,2008. Compensating Human–Wildlife Conflict in Protected Area Communities: Ground-Level Perspectives from Uttarakhand, India. Human Ecology 36,717-729.

Oikonomou,V.,Dimitrakopoulos, P.G. and Troumbis, A.Y.,2011. Incorporating Ecosystem Function Concept in Environmental Planning and Decision Making by Means of Multi-Criteria Evaluation: The Case-Study of Kalloni, Lesbos, Greece. Environmental Management 47:77-92.

Olson,M. 1965. The Logic of Collective Action. Public Goods and Theory of Groups. Cambridge University Press.

Olson, D.M. and Dinerstein, E. ,1998.The Global 200: a representation approach to conserving the Earth's most biologically valuable ecoregions. Conservation Biology, 12: 502–515.

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D.,Powell, G.V.N., Underwood, E.C., D'amico, J.A., Itoua, I.,Strand, H.E., Morrison, J.C., Loucks, C.J., Allnutt, T.F.,Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W.,Hedao, P. and Kassem, K.R. ,2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience, 51:933–938.

Orme, C.D.L., Davies, R.G., Burgess, M., Eigenbrod, F., Pickup, N.,Olson, V.A., Webster, A.J., Ding, T.S., Rasmussen, P.C.,Ridgely, R.S., Stattersfield, A.J., Bennett, P.M., Blackburn,T.M., Gaston, K.J. and Owens, I.P.F. ,2005. Global hotspots of

species richness are not congruent with endemism or threat.Nature, 436: 1016–1019.

Ostrom,E. 1990. Governing the commons:The evolution of institutions for collective action. Cambridge, Cambridge University Press.

Ostrom, E.; Burguer, J.; Field, C.B.; Norgaard, R.B. and Policansky, D. ,1999. Revisiting the commons: Local Lessons, Global Changes. Science 284, 278-282.

Ostrom, E. ,2000.Collective Action and the Evolution of Social Norms. Journal of Economic Perspectives 4: 137-158.

Ostrom, E.,2009. A general Framework for Analyzing Sustainability of Social-Ecological Systems. Science 325: 419-422.

Pavlikakis, G.E. and Tsihrintzis, V.A.2003. Integrating humans in ecosystem management using multi-criteria decision making. Journal of the American Water resources Association April, pp.277-288.

Prato,T.,2001. Modeling carrying capacity for national parks. Ecological Economics 39: 321-331.

Primack,R.B. and Ros, J.,2002. Introducción a la biología de la conservación.Editorial Ariel S.A.

Proctor ,W and Dreschler, M. 2003. Deliberative Multi-criteria Evaluation: A case study of recreation and tourisme options in Victoria Australia. European Society for Ecological Economics, Febr.11-15,2003.

Rodrigues, A.S.L., Akcakaya, H.R., Andelman, S.J., Bakarr, M.I.,Boitani, L., Brooks, T.M., Chanson, J.S., Fishpool, L.D.C., daFonseca, G.A.B., Gaston, K.J., Hoffmann, M., Marquet, P.A.,Pilgrim, J.D., Pressey, R.L., Schipper, J., Sechrest, W., Stuart,

S.N., Underhill, L.G., Waller, R.W., Watts, M.E.J. and Yan, X.2004a.Global gap analysis: priority regions for expanding the global protected-area network. Bioscience, 54:1092–1100.

Rodrigues, A.S.L., Andelman, S.J., Bakarr, M.I., Boitani, L.,Brooks, T.M., Cowling, R.M., Fishpool, L.D.C., da Fonseca,G.A.B., Gaston, K.J., Hoffmann, M., Long, J.S., Marquet, P.A.,Pilgrim, J.D., Pressey, R.L., Schipper, J., Sechrest, W., Stuart,S.N., Underhill, L.G., Waller, R.W., Watts, M.E.J. and Yan, X. 2004b. Effectiveness of the global protected area network inrepresenting species diversity. Nature, 428: 640–643.

Romero, C.1993. Teoría de la decisión multicriterio: Conceptos, técnicas y aplicaciones. Ed. Alianza Universidad Textos.

Roy, B.,1996. Multicriteria Methodology for Decision Aiding. Ed. Kluwer Academic Publisher.

Rudolphi,W. and Haider, W. 2003. Visitor management and ecological integrity: one example of an integrated management approach using Decision Analysis. Journal for Nature Conservation 11: 346-354.

Saaty,T and Vargas, L.2001. Models, methods, concepts and applications of the Analytic Hierarchy Process. Kuwer's Academic Publishers. Boston/Dordrecht/London.

San Emeterio, N.2006. La Nueva Economía Institucional. Editorial Síntesis.

Schmoldt, D.L. and Peterson, D.L.2000. Analytical group decision making in natural resources: methodology and application. Forest Science 46: 62-75.

Schultz, L. and Duit, A.,2010.Participation, Adaptive Co-management, and Management Performance in the World Network of Biosphere Reserves. World Development 39: 662-671.

Scott,J.M.and Csuti,B.,1996. Gap analysis for biodiversity survey and maintenance. En M.L.Reaka-Kudla,D.E.Wilson and E.O.Wilson (eds.),Biodiversity II:Understanding and protecting our Biological Resources:321-340. John Henry Press, Washington, D.C.

Segarra,J. and Dies,B.2008. Importancia del cultivo del arroz en el Parque Natural de la Albufera. Agrícola nº 21: 30-35.

Stoll-Kleemann,S. 2010. Evaluation of management effectiveness in protected areas: Methodologies and results. Basic and Applied Ecology 11: 377-382.

Transparency Internacional, 2011.Corruption Perception Index 2011.

Teeffelen, A.J.A.van., Cabeza, M. and Moilanen, A.2006. Connectivity, probabilities and persistence: comparing reserve selection strategies. Biodiversity and Consevation 15: 899-919.

UNDP ,2011. The Millennium Development Goals Report.

Weintraub, A.,Romero,C.,Bjorndal,T. and Epstein, R. 2007. Handbook of Operations Research in Natural Resources. Ed. Springer Science+Bussiness Media LLC.,2007.

Whitfield, S., Geist, H.J. and Ioris, A.A.R. 2011. Deliberative assessment in complex socioecological systems: recommendations for environmental assessment in drylands. Environmental Monitoring Assessment 183: 465-483.

Wilson, K.A., McBride, M.F., Bode, M. and Possingham, H.P.,2006.Prioritizing global conservation efforts. Nature, 440:337–340.

Wood,L.J. and Dragicevic,S.2007. GIS-based multicriteria evaluation and fuzzy sets to identify priority sites for marine protection. Biodiversity Conservation 16: 2539-2558.

World Bank, 2011. www.worldbank.org Accesed on November 2011.

World Economic Forum,2011. www.weforum.org/issues/global-competitiveness Accesed on November 2011.

WDPA Consortium,2005.World database on protected areas 2005. IUCN, Gland, Switzerland, and UNEP-WCMC, Cambridge, UK.

WWF,2001.Terrestrial ecoregions of the world.

WWF,2005.Terrestrial ecoregions of the world (http://www.worldwildlife.org/science/data.cfm, Accessed on 18 October 2005).

WWF,2007. Tracking progress in managing protected areas around the world. In An analysis of two applications of the Management Effectiveness Tracking Tool developed by WWF and the World Bank. Gland: WWF International.

AGRADECIMIENTOS

Taiga Siberiana (Rusia). Foto: V. Urios.

En primer lugar me gustaría agradecer muy especialmente al Dr.Vicente Urios su constancia, su apoyo y su interés en el desarrollo de esta tesis doctoral. Él ha sido mi referente profesional al que he admirado durante muchos años y me ha hecho meterme en todo esto con los ojos cerrados. Gracias por saber todo lo que sabes.

Quiero agradecer muy especialmente a la Dra. Concha Maroto el apoyo profesional y humano que me ha proporcionado en la última parte de esta tesis. Gracias por dedicarme tu tiempo y por contar conmigo. Sin tu apoyo Concha no habría sido posible acabar esta tesis doctoral. Muchas gracias por todo.

Gracias al Departamento de Estadística e Investigación Operativa Aplicadas y Calidad de la Universidad Politécnica de Valencia, por el apoyo logístico. Gracias a los doctorandos de este departamento (muchos ya doctores) y a todos los compañeros de la Universidad Politécnica que me han hecho pasar tan buenos ratos. Con todo cariño.

Gracias al Dr. Soutullo por su imprescindible colaboración en la primera parte de esta tesis, por orientarme y por su trabajo. Gracias también a Ugo Mellone por su trabajo y a todos los compañeros del Grupo de Investigación Zoología de Vertebrados.

Gracias al Dr. Victoriano Martín y a la Dra. Nieves San Emeterio, y al resto de mis compañeros de la Universidad Rey Juan Carlos de Madrid. Gracias a ellos y a mi paso por esta institución no sólo aprendí, aprendí y aprendí, sino que además dejé allí grandes y muy queridos amigos.

Gracias a la Conselleria de Infraestructuras, Territorio y Medio Ambiente, en especial al personal de la Red de Parques de la Comunidad Valenciana. Gracias a Alfredo González Prieto, Juan Ors Martínez, José Luis Pérez Sopena y Juan Jiménez Pérez. Quiero agradecer a José Segarra, director del Parque Natural de la Albufera de Valencia, por su predisposición y su amabilidad, y a los técnicos del parque, Bosco y Fernando .

Gracias también al servicio Devesa-Albufera del Ayuntamiento de Valencia, a Juan Antonio Vizcaíno y al personal del servicio Devesa-Albufera en general por su colaboración. Gracias en especial a Joan Miquel Benavent, siempre dispuesto a atenderme y a resolver dudas.

Gracias a Vicente Palacios y a Ana García, del Grupo Naturalista Roncadell. A la Comunidad de Regantes Acequia Real del Jucar, a la Comunidad de Regantes Canal de Riego del Río Turia y a los ayuntamientos de Catarroja, Cullera, Massanassa, Silla, Sollana y Sueca. Gracias a todos por colaborar en este trabajo.

También quiero dar las gracias a mis alumnos y alumnas, que han confiado en mí con los ojos cerrados y sin saberlo, me han hecho encontrar mi camino en la vida.

Gracias a María Jesús Sanchís, que me ha acompañado en todo momento a lo largo de esta tesis.

También quiero agradecer muy especialmente la ayuda incondicional, sin preguntar y sin pedir nada a cambio de mi tío, Santiago Pardo. Gracias por estar siempre pendiente de nosotros, porque sin tu ayuda tampoco habría podido acabar este trabajo y porque, sin tú saberlo, me has dado ánimo y fuerza en momentos muy duros. No olvidaré nunca lo que nos has ayudado.

A Isabel Serrano, por el apoyo moral y por el cariño.

Gracias a mi padre por enseñarme a darle valor a lo que no vale dinero.

Gracias a mi madre por estar siempre ahí.

Por último y sobre todo, quiero agradecer a las dos personas más importantes de mi vida, mis hijos Ángel y Álvaro, que me hayan prestado su tiempo y hayan entendido lo inentendible, apoyándome, sonriéndome y queriéndome con toda su alma siempre. Gracias a mis niños, de todo corazón.

La presente Tesis de Dª. MÓNICA DE CASTRO PARDO

ha sido registrada con el nº ____________ del registro de entrada correspondiente.

Alicante ___ de __________ de _____

El Encargado del Registro,

Reserva de Vu-Kan (Vietnam). Foto: V. Urios