FACULTAD DE CIENCIAS DEL MAR
UNIVERSIDAD CATÓLICA DEL NORTE
DOCTORADO EN BIOLOGÍA Y ECOLOGÍA APLICADA

HACIA UN MANEJO BASADO EN ECOSISTEMAS PARA LAS COSTAS CHILENAS: DESARROLLO DE UNA ESTRATEGIA PARA UNA POTENCIAL ÁREA MARINA COSTERA PROTEGIDA DE MÚLTIPLES USOS

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COQUIMBO, 2013

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Resumen

El aumento de la cobertura de áreas marinas protegidas (AMPs) efectivas alrededor del mundo es una meta con amplio consenso. No obstante, el creciente efecto de las actividades antrópicas a nivel global requiere de la aplicación de nuevos enfoques para manejarlas, sobre todo en ambientes costeros donde la conservación biológica debe coexistir con una multiplicidad de usos, intereses y presiones. Utilizando como área de estudio un área ubicada en el norte-centro de Chile (Región de Atacama y Coquimbo) y propuesta recientemente al Gobierno de Chile para su declaración como Área Marina Costera Protegida de Múltiples Usos (AMCP-MU La Higuera-Isla Chañaral), esta tesis plantea como objetivo desarrollar una estrategia de manejo basado en ecosistemas (MBE) para su implementación, considerando que la aplicación de este enfoque es válido y necesario para incorporar las particularidades del sistema socio-ecológico que la soporta. La investigación se desarrolló en dos ámbitos principales: 1) caracterizar las condiciones existentes (escenario actual), y 2) explorar condiciones futuras o deseadas con participación de actores de interés (escenario posible).

Para caracterizar el escenario actual, *primero*, se exploraron los sistemas de gobernanza y manejo ya existentes dentro del área del AMCP-MU. Se analizó el funcionamiento y desafíos de gobernanza bajo un marco analítico de sistemas. A través de diversos procesos ecológicos e interacciones socio-económicas, las diversas medidas espacialmente explicitas (e.g., reservas marinas y terrestres, áreas de manejo) existentes dentro del área del AMCP-MU están altamente conectadas entre ellas y con el sistema socio-ecológico más amplio. Las actuales interacciones institucionales con efectos positivos en la gobernanza y manejo de las medidas espacialmente explicitas y el sistema socio-ecológico en general, son escasas, pero existen

diversas interacciones potenciales que pueden ser desarrolladas (e.g., planes de manejo, sistemas de vigilancia). *Segundo*, se exploraron las posibilidades que ofrece el marco legal e institucional nacional para el desarrollo e implementación del MBE, evaluando el ajuste funcional entre una ecosistema conceptual del AMCP-MU (basado en servicios ecosistémicos, amenazas a su provisión y usos/actividades humanas) y la legislación chilena relacionada con planificación y manejo de recursos marinos y costeros. La legislación escasamente da cuenta de las relaciones definidas entre los diferentes componentes del modelo ecosistémico, observándose un bajo ajuste funcional potencial y muchos vacios entre la legislación y el ecosistema. Por otro lado, se evaluaron instrumentos de manejo y planificación existentes en Chile y su aptitud para soportar la implementación de MBE, encontrándose que efectivamente algunos poseen criterios y principios que definen un MBE y pueden ser utilizados para su implementación a corto plazo (e.g., AMCP-MU). *Tercero*, reconociendo la importancia de las dimensiones humanas y la participación de actores de interés en manejo y planificación de recursos naturales, se investigaron la estructura y propiedades de redes sociales inter-organizacionales de colaboración e intercambio de conocimiento en torno al uso y manejo en el AMCP-MU. Diversos actores sociales de interés fueron identificados y caracterizados en el contexto de la implementación del AMCP-MU. Se encontraron redes inter-organizacionales pocos cohesivas y con baja densidad, indicando un bajo flujo colaborativo y de intercambio de información, lo que podría dificultar la implementación y gobernanza del AMCP-MU. Sin embargo, se identificaron actores claves, como por ejemplo, actores puente que permiten conectar diferentes niveles administrativos (e.g., ONGs, Federaciones de Pescadores), actores centrales respecto al flujo de información científica que se genera en y para el área (e.g.,

Servicio Nacional de Pesca, Consultoras Técnicas), y estrategias que pueden ayudar a mejorar esta situación (e.g., fortalecimiento del trabajo de puente de ciertos actores).

Para avanzar hacia la definición de escenarios futuros, *primero*, se investigó la valoración de diversos componentes ambientales fundamentales para planificar un AMP y el nivel de amenaza que representan diversos usos humanos para la conservación de los servicios ecosistémicos y la biodiversidad, además de las expectativas que genera la implementación del AMCP-MU en actores de interés. Servicios ecosistémicos de soporte como hábitats para especies carismáticas y bosques de macroalgas, de aprovisionamiento como caladeros de pesca, y servicios culturales como avistamiento de vida silvestre, fueron los más priorizados por actores de interés para asegurar su provisión. Características de biodiversidad como bosques de macroalgas, flora endémica, recursos pesqueros y mamíferos marinos fueron las más priorizadas para enfocar los esfuerzos de conservación. Los usos humanos de pesca artesanal, investigación científica, reservas marinas, educación ambiental y ecoturismo fueron considerados como los más importantes de priorizar en un escenario de implementación del AMCP-MU. Los usos humanos como termoeléctricas, pesca industrial, pesca ilegal y minería fueron percibidos como los de mayor nivel de amenaza. Diferencias en la valoración ambiental y la percepción de amenazas entre grupos de actores son explicadas principalmente por las valoraciones de los grupos de pescadores artesanales. Un modelo conceptual simple basado en redes que incorpora servicios ecosistémicos, características de biodiversidad, usos humanos y las relaciones de interdependencia entre ellos fue propuesto para relacionar los diferentes componentes ambientales valorados y como una estrategia para comunicar a los diversos actores de interés, las relaciones y posibles compromisos (*trade-offs*) que ocurren en el AMCP-MU. *Segundo*, considerando que la condición de múltiples usos, los múltiples

grupos de actores sociales de interés y los múltiples objetivos de conservación y manejo, impone desafíos de planificación para el AMCP-MU, probablemente mayores que para las tradicionales reservas o parques marinos, para una implementación efectiva se sugiere un proceso de planificación tipo planificación espacial marino costera (PEMC) altamente participativo y orientado por las particularidades del sistema socio-ecológico (e.g., existencia en el área de medidas de conservación y manejo, ecoturismo como factor de desarrollo económico de las comunidades locales, pesca artesanal como uso tradicional predominante,).

Varios resultados de esta tesis debiesen ser insumos relevantes a considerar e integrar en las primeras etapas del proceso oficial y futuro de planificación del AMCP-MU. Por ejemplo, la identificación de actores sociales y redes de colaboración que permite caracterizar el sistema social y de gobernanza del área, y la valoración y priorización de servicios ecosistémicos, características de biodiversidad y usos humanos que corresponden a elementos claves para definir una visión común para el área, para definir objetos y metas de conservación, y para la planificación espacial o el desarrollo de esquemas de zonificación.

Abstract

Increasing coverage of effective marine protected areas (MPAs) around the world is a widely shared goal. However, increasing anthropogenic activities requires the application of new approaches to manage them, especially in coastal environments where biological conservation must coexist with a multiplicity of uses, interests and pressures. Using as a study system an area located in the north-central Chile (Atacama and Coquimbo Regions) recently proposed to the Chilean Government to declare it as a Multiple-Use Coastal Marine Protected Area (La Higuera-Isla Chañaral MU-CMPA), this thesis aims to develop an ecosystem-based management (EBM) strategy for its implementation, considering the application of this approach as necessary given the particular social-ecological system associated. Two main research subjects were developed to address the objective: 1) characterizing the existing conditions (current scenario) and 2) exploring desired or future conditions involving stakeholders (possible scenario).

To characterize the current scenario, *first* I explored the governance and management systems existing within the MU-CMPA area, analyzing the performance and governance challenges under an analytical framework of systems that recognizes the importance of considering the relationships and interactions between the governing system (social), the system to be governed (natural and social) and the wider social-ecological system that supports them. Through various ecological processes and socio- economic interactions, the various spatially explicit measures (e.g., marine and terrestrial reserves, management areas) existing within the MU-CMPA area are highly connected among themselves and with the wider social-ecological system. Institutional interactions with positive effects on governance

and management of spatially explicit measures and the wider social-ecological system are scarce, but there are various potential interactions that may be developed (e.g., management plans, surveillance). *Second*, I explored the possibilities offered by the national legal and institutional framework for the development and implementation of EBM, evaluating the functional fit between a MU-CMPA conceptual ecosystem (based on ecosystem services, threats to their provision and human uses) and the Chilean legislation related to planning and management of marine resources and coastal areas. The present legislation rarely accounts for relationships between the different components of the ecosystem model, showing a low potential functional fit and many gaps between legislation and the ecosystem. Furthermore, I evaluated management and planning instruments existing in Chile and their suitability to support the implementation of EBM, finding that some instruments have criteria and principles that define an EBM and could be used for short-term implementation (e.g., MU-CMPA). *Third*, recognizing the importance of the human dimension and stakeholder participation in planning and management of natural resources, I studied the structure and properties of inter-organizational social networks for collaboration and exchange of knowledge about the use and management in the MU-CMPA. Different stakeholders were identified and characterized in the context of the MU-CMPA implementation. Inter-organizational networks with litltle cohesion and low density were found, indicating a low-flow of collaboration and exchange of information, which could hinder the MU-CMPA implementation and governance. However, key stakeholders, such as bridging stakeholders connecting different administrative levels (e.g., NGOs, Fishermen Federations) and central stakeholders on the scientific information flow produced in and for the area (e.g., National

Fisheries Service, Technical Consultants) and strategies that can help improve this situation (e.g., strengthening capacity of bridging stakeholders) were identified.

In order to move towards the definition of future scenarios, *first*, I investigated the valuation of several key environmental components to plan an MPA and evaluate the threath level that several human uses represent to the conservation of ecosystem services and biodiversity, and also the expectations generated by the implementation of the MU-CMPA on stakehoders. The supporting services habitat for charismatic species, kelp, the provisioning service fishing grounds, and the cultural service wildlife watching, were the highest prioritized ecosystem services by stakeholders to ensure their supply. Kelps, endemic flora, fishing resources and marine mammals were the most prioritized biodiversity features to focus conservation efforts. Artisanal fishing, scientific research, marine reserves, environmental education and ecotourism were the most prioritized human uses in a hypotethical scenario of MU-CMPA. Coal-fired power plants, industrial fishing, illegal fishing and mining were considered as the most threatening human uses. Environmental valuation differences between groups of stakeholders were explained mainly by the different valuations by artisanal fishermen groups. A network-based conceptual model incorporating ecosystem services, biodiversity features, human uses and the interdependence between them, was proposed to relate the different environmental components valued and also as a strategy to communicate relationships and trade-offs occurring in the MU-CMPA to the several stakeholders. *Second*, considering that the MU-CMPA can be a potential instrument to implement EBM in Chile and its condition of multiple uses, multiple stakeholders and multiple conservation and managenent goals involve great challenges to plan, probably greater than for marine reserves or parks. A highly participatory planning process such as coastal and marine spatial planning

(CMSP) highly participatory and guided by the distinctive features of the social-ecological system (e.g., pre-existing management and conservation measures in the area, traditional artisanal fishing as a traditional and historical predominant use, ecotourism as a new driver of economic development of local communities) is suggested for an effective implementation.

Many results of this thesis should be relevant inputs to consider and incorporate in the first stages of formal and future MU-CMPA planning process. For example, the identification of stakeholders and collaborative networks to characterize the social and governance system of the area, and the valuation and prioritization of ecosystem services, biodiversity features and human uses that arekey elements to define a common vision for the area, conservation objects and targets, and to develop spatial planning or zoning schemes.

Dedicatoria

Muchas personas y situaciones pasadas y presentes inspiraron este trabajo. Sin embargo, estas últimas semanas de intensa escritura me han acompañado…recuerdos del pasado…imágenes de canoeros Yámanas, Kawéskar, Chonos, Rapa Nui y Changos, de amigos lafkenches y huilliches navegando/caminando sus costas en busca de alimento y refugio…y también, visiones del futuro, mis hijos y todos los hijos caminando por playas y costas aún bellas e intimidantes, extasiándose con una puesta de sol, descubriendo bichitos bajo las rocas, respirando el mar. Dedico esta tesis a los hombres y mujeres pasados, presentes y futuros que se maravillan con el mar, que viven con el mar y sus costas, y que lucharon y luchan por su conservación

.-.

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ALA: Área de libre acceso

AMERB: Áreas de Manejo y Explotación de Recursos Bentónicos

AMCP-MU: Área Marina Costera Protegida de Múltiples Usos

AMP: Área marina protegida

CONAF: Corporación Nacional Forestal

CBD: Convenio sobre la Diversidad Biológica

HSTD: Herramienta de soporte para la toma de decisiones

IUCN: Organización Internacional para la Conservación de la Naturaleza

MBE: Manejo basado en ecosistemas

ONG: Organización no gubernamental

PEMC: Planificación espacial marina costera

RM: Reserva marina

RNPH: Reserva Nacional Pingüino de Humboldt

SERNAPESCA: Servicio Nacional de Pesca

SNASPE: Sistema Nacional de Áreas Silvestres Protegidas por el Estado

List of abbreviations

AFOR: Artisanal Fishermen Organization

ALS: Agriculture and Livestock Service

ANOSIM: Analysis of similarity

CBD: Convention on Biological Diversity

CMSP: Coastal and marine spatial planning

CSO: Civil Society Organization

DC: Diving Centers

DIR: Direct users

DMT: Direction of Maritime Territory

DOR: Diving Organization

DPW: Direction of Port Works

EBM: Ecosystem-based management

EDUC: Local elementary school

ES: Ecosystem goods and services

FDI: Fisheries Development Institute

FZC: Fisheries Zonal Council

HPNR: Humboldt Penguin National Reserve

ICHD-MR: Islas Choros-Damas Marine Reserve

IFOR: Industrial Fishermen Organization

IG-NPA: Gaviota Island National Protected Asset

IND: Indirect users

I_NGO: International NGO

IUCN: International Union for Conservation of Nature

LAND_OWN: Land Owners

LCOM: Local communities

LOG: Local Government

MDS: Multidimensional scaling ordination

MEARB: Management and Exploitation Area for Benthic Resources

MIN_E: Environment Ministry

MIN_H: Housing Ministry

MIN_NA: Ministry of National Assets

MPA_B: Marine Protected Areas Boards

MSP: Marine spatial planning

MU-CMPA: Multiple-Use Coastal Marine Protected Area

MUN: Municipalities

NA: Neighborhood Associations

NAG: National Government Agencies

NAG_FUND: National Government Funding Agencies

NFC: National Forestry Corporation

NFS: National Fisheries Service

NGO: Non-govermental Organization

NSPWA: National System of Protected Wildlife Areas

NTS: National Tourism Service

PA_B: Terrestrial Protected Areas Boards

POLICE: National Police

PPC: Public-Private Committee

QAP: Quadratic assignment procedure

RCCB: Regional Commission of Coastal Border

REG: Regional Government Agencies

RES: University or Research Institute

RG: Regional Government

R_NGO: Regional NGO

SA: Stakeholder analysis

SECMMs: Spatially Explicit Conservation and/or Management Measures

SIMPER: Similarity percentages routine

SNA: Social network analysis

TCO: Technical Consultant

TE: Tourism Enterprises

TOUR: Tourism enterprise

UN: Universities

Publicaciones asociadas a la tesis

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Cárcamo, P.F., Garay-Flühmann, R., Gaymer, C.F. 2013. Opportunities and constraints of the institutional framework for the implementation of an ecosystem-based management: The case of the Chilean coast. Ocean & Coastal Management 84: 193-203.

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Capítulo 1. Introducción general

1.1. Contexto de la tesis

1.1.1. Manejo de recursos naturales: del enfoque sectorial a uno basado en ecosistemas

Los ecosistemas marinos y costeros proporcionan una gran variedad de bienes y servicios que son esenciales para la mantención del bienestar de nuestra sociedad (MEA 2005, Beaumont et al. 2007), sin embargo, diversas presiones antropogénicas impactan directa o indirectamente a su funcionamiento y la capacidad de proveer servicios (MEA 2005). La sobreexplotación pesquera, la pérdida de hábitat y biodiversidad y la contaminación acuática son amenazas de preocupación mundial (Pauly et al. 2002, MEA 2005, Worm et al. 2006), que sumadas a la vulnerabilidad de los ecosistemas marinos y costeros frente a los impactos del cambio climático (Hoegh-Guldberg & Bruno 2010, Nicholls & Cazenave 2010), han puesto en alerta a la comunidad global sobre la salud actual y a largo plazo de los ecosistemas. Diversos esfuerzos se realizan para responder cómo los ecosistemas costeros marinos pueden ser mejor manejados en el contexto de las diferentes amenazas derivadas de la acción del hombre (Crain et al. 2009).

La integración efectiva de la ciencia en la creación e implementación de políticas y acciones de manejo es considerada como fundamental para el logro de metas ambientales y de desarrollo sustentable de cualquier región (Cheong 2008, McLeod & Leslie 2009). Los esfuerzos de la ciencia aplicada deben centrarse en proporcionar información robusta que permita reducir la incerteza científica y permitir la evaluación de diferentes alternativas de manejo. Por otro lado, la comunicación y comprensión de conceptos científicos por parte de políticos y manejadores de recursos es un tema fundamental para la integración del conocimiento científico en la creación de políticas ambientales y de manejo, para ello, la

comunicación debe apuntar a transmitir conceptos y resultados operacionales, accesibles y útiles (Watson-Wright 2005, Grorud-Colvert et al. 2010).

Así mismo, es indudable que los enfoques tradicionales de manejo y explotación de recursos naturales basados en objetivos, sectores, actividades o especies únicas han priorizado la productividad y rentabilidad económica a corto plazo (Rosenberg & McLeod 2005, Tallis et al. 2010), y generalmente, no incorporan de manera integral, el conocimiento científico disponible (e.g., conectividad entre hábitats, especies y ecosistemas o los compromisos (*trade-offs*) entre la salud del ecosistema y el bienestar social y económico humano) (Lubchenco & Sutley 2010).

El manejo basado en ecosistemas (MBE) corresponde a un enfoque holístico y basado en ciencia que promueve el uso sustentable de los recursos naturales e intenta manejar la amplia gama de actividades humanas que afectan a los ecosistemas (Grumbine 1994, McLeod et al. 2005, Arkema et al. 2006). Su adopción implica cambios de paradigmas y nuevos desafíos para las instituciones científicas y de gobernanza (Ruckelshaus et al. 2008, McLeod & Leslie 2009, Carollo & Reed 2010).

Existe una variedad de definiciones para MBE y otros conceptos utilizados como aproximaciones similares (e.g., manejo o enfoque ecosistémico, manejo de pesquerías basado en ecosistemas), y varios intentos por definir su base científica, principios, metas y objetivos (Grumbine 1994, Christensen et al. 1996, Slocombe 1998, Arkema et al. 2006, Leslie & McLeod 2007, McLeod & Leslie 2009, Kidd et al. 2011). Una definición general para MBE es que corresponde a un manejo basado en el lugar o región que considera el ecosistema completo y las conexiones entre sus diferentes componentes, incluyendo las fuertes conexiones entre los sistemas sociales y naturales (i.e., sistemas socio-ecológicos acoplados),

y que se focaliza en mantener al ecosistema en una condición saludable, productiva y resiliente para que pueda proporcionar los servicios que los humanos quieren y necesitan (Grumbine 1994, McLeod et al. 2005, McLeod & Leslie 2009) (Fig. 1.1). McLeod & Leslie (2009) señalan que el concepto de MBE está fundamentado en la idea que los humanos manejan las actividades humanas que afectan a los ecosistemas más que a los ecosistemas mismos.

El MBE considera a los humanos como parte integral de los ecosistemas, ya que las personas se benefician de los ecosistemas y actúan como agentes que influencian los procesos ecosistémicos (Levin et al. 2009) (Fig. 1.1). Por ello, el MBE que promueve la sustentabilidad ambiental y la provisión de beneficios socio-económicos requiere de la incorporación efectiva de información científica que permita entender los *trade-offs* entre servicios ecosistémicos y actividades humanas (Granek et al. 2010).

El uso del concepto servicios ecosistémicos, entendidos como los beneficios que los humanos reciben directa o indirectamente de los ecosistemas (Costanza et al. 1997), es promovido como un enfoque que permite integrar las dimensiones ecológicas y socio-económicas de una manera útil para la toma de decisiones (Farber et al. 2006, Tallis et al. 2009) (Fig. 1.1). Utilizar el concepto de servicios ecosistémicos proporciona un lenguaje común a los diferentes actores de interés y puede facilitar comparaciones entre alternativas de manejo (Granek et al. 2010). Focalizar el manejo en servicios ecosistémicos más que en el funcionamiento del ecosistema *per se* permite reconocer y dar cuenta de los factores físicos, ecológicos y sociales que afectan la producción y provisión de éstos (McLeod & Leslie 2009). Últimamente, iniciativas de conservación de la biodiversidad terrestre han comenzado a incorporar bienes o servicios ecosistémicos como un objetivo más dentro de sus objetivos de conservación (Egoh

et al. 2010, Reyers et al. 2012). La evaluación de servicios ecosistémicos puede involucrar análisis cualitativos y cuantitativos, desde una representación conceptual de cómo las actividades humanas dependen y afectan los ecosistemas hasta la cuantificación del valor monetario de servicios particulares (Leslie & McLeod 2007, Granek et al. 2010).

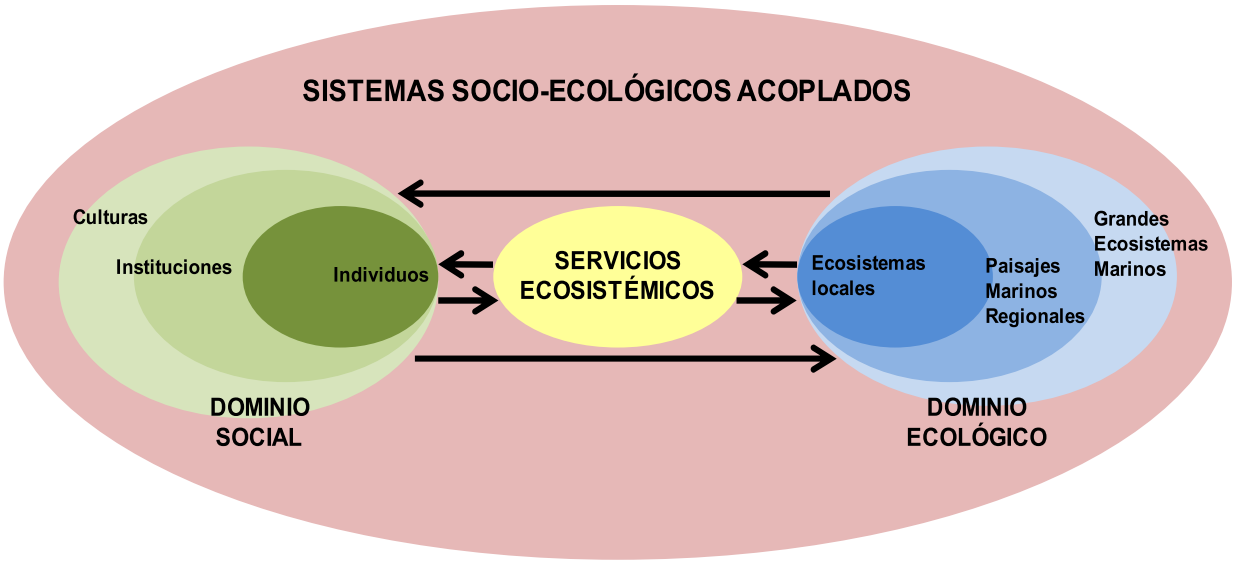

Fig. 1.1. Diferentes interacciones existentes entre sistemas humanos y sistemas ecológicos reconocidas en el MBE. Los dominios social y ecológico pueden interactuar a diferentes escalas organizacionales y geográficas, siendo la comprensión de las conexiones, a través de los diferentes dominios y escalas, crítica para la implementación y éxito a largo plazo de iniciativas de MBE. Los servicios ecosistémicos representan una conexión clave entre los dominios y su flujo, es afectado tanto por factores ecológicos como sociales (Figura modificada a partir de McLeod & Leslie 2009).

1.1.2. Participación e integración de los actores de interés

Cualquier región a manejar contiene una amplia gama de grupos, actores o partes interesadas o de interés (*stakeholders*) que están involucrados, interesados o son afectados por la toma de decisiones respecto de una medida de manejo de recursos naturales (Pomeroy & Douvere 2008). Estos actores pueden ser gestores de recursos, agencias de gobiernos, residentes, organizaciones comunitarias, usuarios, líderes tradicionales, científicos, comunidades indígenas, conservacionistas, entre otros. Dada la alta interdependencia entre recursos naturales y humanos concebida bajo el MBE, la identificación y comprensión de los diferentes actores de interés, sus estructuras organizativas (e.g., redes sociales de colaboración), sus percepciones, prácticas, expectativas e intereses es fundamental para su implementación (Gelcich et al. 2005, Fischer & Young 2007, Pomeroy & Douvere 2008, Prell et al. 2009). Es importante considerar que los actores de interés no siempre son un grupo de individuos fácilmente identificables o habitando una comunidad geográfica única o adyacente a una medida como un área protegida.

Existe suficiente evidencia de que la aceptación, involucramiento y participación temprana de los actores de interés en la planificación y actividades de toma de decisión es clave para la implementación efectiva de medidas de manejo y conservación marina (Pollnac & Pomeroy 2005, Pomeroy & Douvere 2008, Rodríguez-Martínez 2008).

1.1.3. Áreas marinas protegidas como parte integral del manejo basado en ecosistemas

Las áreas marinas protegidas (AMPs) corresponden a una herramienta ampliamente utilizada para el manejo pesquero y la conservación de la biodiversidad marino costera (Roberts et al. 2005, Gaines et al. 2010). Adicionalmente, las AMPs pueden diversificar y aportar a las economías locales, por ejemplo, a través de actividades no extractivas como el ecoturismo (Oracion et al. 2005).

Dependiendo del nivel de protección, usos y actividades permitidas y objetivos, las AMPS pueden incluir diferentes sub-tipos, como por ejemplo, reservas marinas, parques marinos, santuarios, AMPs de múltiples usos. En los últimos años ha ocurrido un aumento considerable en la declaración de AMPs alrededor del mundo (Wood 2011). Revisiones globales indican efectos positivos en biomasa, densidad, riqueza de especies y tamaño de organismos al interior de reservas marinas (Harmelin-Vivien et al. 2008, Lester et al. 2009). Adicionalmente, beneficios fuera de los límites de reservas marinas se pueden producir vía exportación de biomasa (e.g., emigración de adultos y juveniles, exportación de propágulos) (Gell & Roberts 2003, Abesamis & Russ 2005).

La efectividad de las AMPs como medida de manejo le ha valido ser considerada como una herramienta esencial en el MBE (Browman & Stergiou 2004, Halpern et al. 2010). Sin embargo, aún si las AMPs son bien manejadas y vigiladas, la mayoría no cubren grandes extensiones de superficie, y es probable que no puedan proteger integralmente a las comunidades biológicas residentes de otros impactos ambientales antropogénicos (Thrush & Dayton 2010, Agardy et al. 2011). En este sentido, las AMPs pueden ser reforzadas si se encuentran dentro de un área mayor manejada con MBE. Por otro lado, las AMPs de mayor

nivel de protección (e.g., reservas o parques marinos) pueden contribuir al cumplimiento de metas del MBE, reduciendo los impactos acumulativos de estresores ambientales (e.g., sobreexplotación pesquera), dando protección a zonas o hábitat particulares y permitiendo una mejor comprensión de las relaciones ecológicas (Halpern et al. 2010).

1.1.4. Implementación del manejo basado en ecosistemas

Para la implementación efectiva del MBE es fundamental crear una red de manejo adaptativo y flexible, lo que significa adoptar cambios organizacionales que apunten a: i) colaborar de forma interdisciplinaria a través de múltiples niveles, ii) involucrar a los actores de interés, iii) incorporar y compartir información científica relevante, iv) incorporar el conocimiento y opiniones de los actores de interés, v) unir e integrar ciencia y política, y vi) tomar decisiones de forma colaborativa (Reed 2008, McLeod & Leslie 2009, Carollo & Reed 2010, Granek et al. 2010, Kidd et al. 2011).

McLeod & Leslie (2009) señalan que no hay una manera única o correcta de implementar el MBE, ya que éste puede ser puesto en práctica en diferentes lugares y través de una gama de escalas espaciales, cada una con un contexto histórico, social, institucional y ecológico particular. Leslie & McLeod (2007) y Rosenberg & Sandifer (2009) indican algunos principios que pueden guiar el desarrollo e implementación de un proyecto de MBE: i) establecimiento de metas y una visión común para conservar servicios ecosistémicos y mantener o mejorar la resiliencia del ecosistema, reconociendo que las metas son claves para poner en práctica las políticas de manejo, ii) determinación de la escala espacial para planificar el manejo, reconociendo que los límites naturales son más relevantes para la conservación de

servicios que los límites artificiales (e.g., límites comunales o regionales), iii) integración de los diversos sectores de actividades humanas que potencialmente impactan un ecosistema particular bajo estructuras de gobernanza, iv) reconocimiento y consideración de los impactos acumulativos y los *trade-offs* en servicios ecosistémicos entre las diferentes actividades humanas, v) toma de decisiones bajo incerteza, que debe hacerse bajo el contexto del principio precautorio y apoyándose en la mejor información disponible desde el comienzo, vi) evaluación de metas logradas, a través de un monitoreo que incluya el desarrollo y aplicación de indicadores institucionales, sociales, económicos y ecológicos del sistema de interés, y que permitan realizar mejoras en el manejo (i.e., manejo adaptativo).

Diversos procesos, metodologías y herramientas pueden ayudar a planificar e implementar el MBE. Dada la importancia del sistema humano dentro del MBE, el análisis de los actores de interés es un proceso clave a desarrollar de forma temprana. El análisis de actores (análisis de *stakeholders*) corresponde a un proceso que permite la identificación y descripción de individuos y grupos afectados por una decisión o acción, sus interrelaciones, sus intereses, sus objetivos actuales y potenciales, además, examina el cómo y en qué magnitud representan a los diversos segmentos de la sociedad y cómo pueden o deberían ser involucrados en la toma de decisiones (Pomeroy & Douvere 2008, Reed 2008, Bodin & Prell 2011). El análisis de redes sociales es una de las herramientas utilizadas para asistir el proceso de análisis de actores de interés y corresponde al estudio de la estructura social y las relaciones entre actores claves (Freeman 2004). Recientemente, este tipo de análisis está comenzando a utilizarse para explicar o asistir procesos colaborativos dentro del manejo de recursos naturales y gobernanza ambiental (Bodin & Crona 2009, Bodin & Prell 2011).

Luego, uno de los pasos claves dentro del MBE lo constituye la determinación de objetivos y metas. Para ello, herramientas o metodologías para la identificación y valoración de servicios ecosistémicos de un área particular y el análisis de *trade-offs* bajo diferentes escenarios de manejo pueden contribuir a una determinación común por parte de los diferentes actores de interés (Daily et al. 2009). La identificación de amenazas e impactos producto de las actividades humanas también es considerada como crítica para la implementación del MBE, y por lo tanto, el uso de herramientas que permitan su identificación, cuantificación y mapeo contribuyen a la determinación de metas de manejo y a su incorporación en la planificación espacial (Halpern et al. 2008).

En la actualidad existen pocos marcos de referencia que faciliten la planificación integrada y comprensiva en relación a las diversas actividades que toman lugar en áreas marinas (e.g., zonas de pesca, concesiones de acuicultura, reservas marinas, turismo). La inexistencia de marcos a menudo se traduce en situaciones como: superposición espacial y temporal de actividades humanas y sus objetivos, causando conflictos, descoordinación entre autoridades responsables de las diversas actividades individuales o de la protección y manejo ambiental, y una carencia de protección de áreas marinas ecológica y biológicamente relevantes (Douvere 2008). Además, diversas actividades humanas pueden interactuar y tener impactos acumulativos y/o sinérgicos sobre el ecosistema marino provocando respuestas inesperadas en su funcionamiento y productividad (Breitburg & Riedel 2005). La planificación espacial marina costera (PEMC) proporciona un proceso integrado que trata efectivamente estas situaciones y es considerada como esencial para la implementación del MBE (Douvere 2008, Gilliland & Laffoley 2008, Ehler & Douvere 2009, Foley et al. 2010). La PEMC ha sido descrita como un proceso público para analizar y localizar la distribución espacial y temporal

de actividades humanas en áreas marinas y costeras para lograr objetivos ecológicos, económicos y sociales que usualmente son determinados a través de un proceso político (Ehler & Douvere 2009).

La primera etapa de la PEMC corresponde a la planificación y análisis, y está basada en varias instancias de investigación que incorporan los procesos humanos y ambientales (Crowder et al. 2006, St. Martin & Hall-Arber 2008, Ehler & Douvere 2009). El resultado principal de esta etapa, es uno o varios planes espaciales integrales que corresponden a una visión del futuro de la región o ecosistema y que debiese reflejar las metas y objetivos de una visión común definida por los actores de interés y los tomadores de decisión (Douvere & Ehler 2009, Ehler & Douvere 2009). Una segunda etapa corresponde a la implementación del plan espacial a través de sistemas de zonificación detallados, regulaciones de zonificación y sistemas de permisos, entre otros (Blæsbjerg et al. 2009, Douvere & Ehler 2009). Finalmente, la etapa de monitoreo y evaluación, permite evaluar la efectividad de los planes y eventualmente adaptarlos y mejorarlos (Day 2008, Ehler & Douvere 2009).

La PEMC que incorpora totalmente al componente bio-físico de un ecosistema marino las superposiciones socio-económicas, jurisdiccionales y de gobernanza, puede ser muy informativa para la designación y emplazamiento de usos marinos costeros y para el manejo de actividades que mantengan o restauren ecosistemas saludables, permitiendo la provisión de servicios ecosistémicos y un uso sustentable de los recursos marinos (Crowder et al. 2006, Foley et al. 2010).

1.1.5. Planificación y manejo basado en ecosistemas en zonas costeras y marinas de Chile

En nuestro país las diversas actividades y usos humanos que se realizan en zonas marinas y costeras son reguladas por diferentes agencias, políticas y reglamentos que muchas veces se superponen en funciones (e.g., Ley General de Pesca y Acuicultura, Política Nacional del Uso del Borde Costero, Planes Reguladores Comunales e Intercomunales). Como ejemplo, el programa nacional de zonificación de uso del borde costero, instrumento de gestión territorial y de aplicación reciente, define usos preferentes (e.g., turismo, acuicultura, pesca). Sin embargo, este proceso es aún deficitario en cuanto a los principios y etapas definidas para un proceso de PEMC, además, es limitado solo a la franja litoral y produce esquemas de zonificación de usos del borde costero solo indicativos (Andrade et al. 2008). Por otro lado, existen comunas o provincias cuyo borde costero se encuentra en gran medida ocupado por concesiones de acuicultura o designados como áreas aptas para la acuicultura, haciendo muy difícil la asignación de otros nuevos usos (e.g., conservación de la biodiversidad) y el desarrollo armónico del territorio, por ejemplo, a escala regional (e.g., déficit de áreas protegidas). Procesos de planificación sistemática de la conservación en Chile y en ambientes fuertemente influenciados por actividades humanas son escasos, limitándose principalmente a ejercicios académicos (Rojas-Nazar et al. 2012, Ulloa et al. 2013).

Otro ejemplo son las numerosas categorías de protección y conservación de la biodiversidad marina y terrestre que existen en Chile. Estas formas legales dependen de diversos ministerios y no existen instrumentos de gestión adecuados para garantizar que estas categorías de protección sean efectivas. Existe un proyecto de Ley para la creación del Servicio de Biodiversidad y Áreas Protegidas, contemplado en el marco de la nueva institucionalidad

ambiental chilena (Ley Nº 20.417 que crea el Ministerio del Medioambiente), que sería el organismo encargado de administrar la totalidad de las áreas protegidas marinas y terrestres chilenas, sin embargo, aún se encuentra en discusión en el Congreso Nacional.

Gelcich et al. (2009a) señalan que los principios del MBE no están explícitamente incluidos en las políticas y planes de manejo y conservación de recursos marinos en Chile, sin embargo, hay políticas e instrumentos de nivel local que pueden favorecer la inclusión e implementación de los principios del MBE (e.g., Plan de Desarrollo Comunal). Por otro lado, Marín & Delgado (2005) señalan que los planes de manejo para recursos naturales en Chile, generalmente, son concebidos por grupos de expertos amparados en sus investigaciones y adolecen de participación ciudadana. De Andrade (2007) señala que se hace necesario avanzar hacia una mirada más holística desde el punto de vista de la gestión de la biodiversidad marina nacional, cambiando el enfoque, desde uno parcial hacia uno ecosistémico. En el marco de la administración de las principales pesquerías pelágicas chilenas, Leal et al. (2010) señalan que el riesgo de sobreexplotación pesquera es agravado por fallas a nivel de toma de decisiones, donde los organismos resolutivos priorizan objetivos sociales y económicos de corto plazo por sobre metas de conservación y el aseguramiento de la sustentabilidad a largo plazo de las pesquerías. La definición y comprensión de escalas espaciales y temporales mayores (e.g., más allá del centro de cultivo o pesquería específica) y la integración efectiva de factores y variables ambientales, productivas, sanitarias, económicas y sociales, en general, ha estado poco presente en la planificación y desarrollo de actividades fundamentales para la economía nacional como la pesca y acuicultura (Buschmann et al. 2009, Castilla 2010, Gelcich et al. 2010, Leal et al. 2010, Clément 2013). Como ejemplo, podemos citar la crisis sanitaria experimentada por la industria salmonicultora a partir del año 2007 (Asche et al. 2010), donde

el modelo de administración y manejo basado en el centro de cultivo demostró ser inapropiado para hacer frente al brote epidémico.

1.2. Fundamentación de la tesis

Chile tiene serios problemas en cuanto a cobertura de AMPs y su representatividad ecológica, estando muy lejos de alcanzar las metas cuantitativas comprometidas en acuerdos internacionales como la Convención de Diversidad Biológica (Squeo et al. 2012). Presenta además, niveles de financiamiento para áreas protegidas mínimos considerando la presencia de biodiversidad amenazada (Waldron et al. 2013). De las 15 AMPs existentes en la actualidad (área total ~ 15.080.657 ha), sólo el Parque Marino Motu Motiro Hiva, ubicado a 410 km al noreste de Isla de Pascua, aporta con el 99,5% de cobertura. Además, muchas de las AMPs existentes no se encuentran completamente implementadas y la participación ciudadana e involucramiento de actores de interés en los procesos de declaración, planificación, implementación y operación de éstas ha sido muy escaso, reflejando claramente procesos tipo *top-down*, manejados principalmente a través del gobierno central (Fernández & Castilla 2005, Vega 2011, Jorquera-Jaramillo et al. 2012).

La efectividad de las AMPs (sobre todo las pequeñas como las reservas marinas) estará condicionada principalmente por el buen manejo y salud ecosistémica de las áreas que los rodean (Agardy et al. 2011). Por otro lado, en gran parte de nuestras costas las AMPs existentes o las futuras deberán coexistir con diferentes usos marítimos (e.g., navegación), usos costeros-terrestres (e.g., termoeléctricas, ciudades), actividades (e.g., pesca, turismo, recreación), concesiones espaciales para explotación (e.g., acuicultura) y manejo pesquero

(e.g., áreas de manejo), lo que inevitablemente aumentará la complejidad para su funcionamiento, implicando desafíos de manejo y gobernanza para el logro de metas propias de las AMPs y metas de conservación regionales y nacionales. Esto último, nos conduce a entender a una AMP como un "sistema gobernante" inmerso dentro de un sistema socio-ecológico más amplio, donde la comprensión de las relaciones e interacciones entre el AMP y el sistema socio-ecológico será fundamental para: i) definir los desafíos de gobernanza y manejo que apuntan al logro de las metas del AMP (Jentoft et al. 2007), y ii) mejorar la resiliencia del sistema de gobernanza del AMP lo que a su vez se traducirá en dar resiliencia al sistema socio-ecológico que la soporta (Jones et al. 2013).

Considerando el panorama chileno actual de explotación y manejo de recursos naturales, marcado por la sobreexplotación pesquera, el deterioro ambiental, los conflictos de uso del borde costero, los conflictos entre la conservación de la biodiversidad y el desarrollo económico, y una institucionalidad ambiental aún incipiente (al menos en cuanto al desarrollo y fortalecimiento de la planificación y conservación marina), se torna urgente explorar formas flexibles, integradas y holísticas de gobernanza y manejo que enfrenten la complejidad de un sistema socio-ecológico particular, abordando los conflictos entre usos y usuarios, proponiendo soluciones de conservación y manejo de la biodiversidad marina y costera, e incorporando efectivamente la visión, metas y objetivos de la comunidad afectada y la información científica disponible. El involucramiento temprano de los actores de interés y la incorporación de sus objetivos y metas en la planificación de AMPs puede disminuir el rechazo y crear un sentido de propiedad del AMP que mejoraría su funcionamiento (Voyer et al. 2013).

Esta tesis explora diferentes aspectos que contribuyen al desarrollo de una estrategia de manejo basado en ecosistemas para áreas marinas costeras, desde un diagnóstico del área desde el punto de vista de la gobernanza, pasando por análisis de los actores de interés, hasta el uso de herramientas para planificar incorporando servicios ecosistémicos y los intereses de los actores. La premisa de esta tesis es que el estudio e incorporación de la dinámica del sistema socio-ecológico particular es un factor clave en el éxito de la planificación y en la implementación de acciones de conservación y manejo de recursos naturales.

Se utilizó como área de estudio un área recientemente propuesta al Gobierno de Chile como Área Marina Costera Protegida de Múltiples Usos (AMCP-MU) La Higuera-Isla Chañaral (Oceana 2010). Las AMCP-MU pueden definirse como herramientas de gestión para la protección, administración, mantención y restauración de los recursos naturales y culturales de las aguas marinas y costeras, y sus objetivos, generalmente, apuntan a conservar la biodiversidad, conservar el patrimonio cultural, reducir los conflictos de uso, promover la investigación científica y desarrollar actividades comerciales y recreativas de bajo impacto ambiental (Badal 2007). Este tipo de AMP se establece con atribuciones legales de varios ministerios (e.g., Ministerio del Medio Ambiente, Ministerio de Bienes Nacionales) y se ha propuesto para su administración el involucramiento de organismos públicos y privados, gobiernos regionales y ONGs. Las AMCP-MUs son consideradas homólogas a la categoría VI de áreas protegidas de la IUCN (Sierralta et al. 2011). A priori, se considera que un escenario complejo para la conservación puede ser abordado a través de un enfoque como el MBE con énfasis en la planificación basada en actores de interés relevantes y utilizando una AMCP-MU como herramienta para su implementación.

1.3. Área de estudio

1.3.1. Ecosistema natural

El área de estudio de esta tesis corresponde a la propuesta existente de AMCP-MU La Higuera-Isla Chañaral que se extiende desde Punta Pájaros, al norte de la Caleta Chañaral de Aceituno (28°54' S, Comuna de Freirina, Región de Atacama), hasta Punta Poroto, ubicada al sur de Caleta Los Hornos (29°45' S, Comuna de La Higuera, Región de Coquimbo). Abarca una superficie marítima aproximada de 3.445 km^2 y una franja de tierra costera frente a la porción de mar de unos 294 km de longitud (Fig. 1.2) (Oceana 2010). Esta área pertenece al sistema costero de Coquimbo que corresponde a un ecosistema marino costero representativo de la región de transición templada del Sistema de la Corriente de Humboldt (Thiel et al. 2007, Montecino & Lange 2009). Una de las características particulares del área es un sistema insular formado por diferentes islas e islotes como Isla Chañaral, Isla Choros e Isla Damas y los islotes Pájaros 1 y 2, Tilgo, Chungungo y Totoralillo. Este sistema brinda condiciones óptimas para la nidificación de una gran diversidad de aves marinas, muchas de las cuales son endémicas del sistema de surgencia de la Corriente de Humboldt (Hertel et al. 2005, Luna-Jorquera et al. 2012), haciendo además, un aporte relevante a la diversidad local y global de aves marinas, ya que aquí se encuentran 33 especies de las 115 que se distribuyen a lo largo de la costas de Chile (Luna-Jorquera et al. 2003, Thiel et al. 2007). En el área encontramos la colonia más grande de pingüino de Humboldt (*Spheniscus humboldti*) en el mundo y un 80 % de la población mundial de esta especie (Mattern et al. 2004). Además, el área constituye el hábitat permanente de poblaciones de mamíferos marinos como la nutria de mar (*Lontra felina*), el lobo marino común (*Otaria flavescens*), el delfín nariz de botella (*Tursiops*

truncatus) y el hábitat estacional de especies migratorias como la foca elefante (*Mirounga leonina*), la ballena jorobada (*Megaptera novaeangliae*), la ballena de aleta (*Balaenoptera physalus*), la ballena azul (*Balaenoptera musculus*), entre otros (Capella et al. 1999, Pérez et al. 2006, Sepúlveda et al. 2007, Thiel et al. 2007, Luna-Jorquera et al. 2013).

Entre las comunidades bentónicas destacan los bosques de algas *Lessonia spicata*, *Lessonia berteroana*[1], *Lessonia trabeculata* y *Macrocystis integrifolia* que albergan una gran diversidad de algas, invertebrados y vertebrados marinos, pero también algunas comunidades extraordinariamente singulares y frágiles como praderas de pasto marino (*Heterozostera chilensis*) y praderas de gorgónidos (Gaymer et al. 2008).

El área es una las más productivas y de mayores reclutamientos del molusco loco (*Concholepas concholepas*) de las regiones de Atacama y Coquimbo, lo que se debe fundamentalmente a la presencia de uno de los dos focos de surgencia estacional que se conocen en la región y a la topografía costera con salientes e islas que generan la llegada y gran retención de larvas de loco (Thiel et al. 2007). Corresponde además, a una de las zonas con mayores tasas de desembarque de pesquerías bentónicas de la región, aportando un ~60 % del desembarque de locos de la región de Coquimbo (Thiel et al. 2007, Tirado & Cano 2009).

Desde el punto de vista biogeográfico, esta área es el inicio de una zona definida como de transición biogeográfica donde existe una superposición difusa de biota de las provincias biogeográficas peruana y magallánica (Camus 2001) y donde se han documentado cambios abruptos en la abundancia, diversidad y patrones de reclutamiento de especies de invertebrados bentónicos (Broitman et al. 2001). Estos cambios han sido asociados principalmente con la discontinuidad observada a partir de los 30º en las condiciones

[1] Tanto *L. spicata* como *L. berteroana* corresponden a especies crípticas recientemente identificadas a partir del complejo *Lessonia nigrescens* (González et al. 2012)

oceanográficas y atmosféricas (Broitman et al. 2001) que implican un fuerte quiebre en los patrones de circulación (Hormazabal 2004). Recientemente, diversos estudios han incorporado aproximaciones filogeográficas para evaluar la significancia de esta área en la especiación y distribución de especies (e.g., Cárdenas et al. 2009, Tellier et al. 2009, Brante et al. 2012).

El área terrestre de emplazamiento del AMCP-MU corresponde al límite sur del Desierto de Atacama, caracterizado por un clima desértico con abundantes días nublados, un alto contenido de humedad y temperaturas moderadas debido a la influencia del Anticiclón Subtropical del Pacifico Sur y la corriente fría de Humboldt (Juliá et al. 2008). En esta área existe una alta diversidad de plantas vasculares nativas y un gran porcentaje de ellas son endémicas de Chile y se encuentran con problemas de conservación destacando la varilla (*Adesmia littoralis*), el capachito (*Calceolaria picta*) y el lucumillo (*Myrcianthes coquimbensis*), todas con serios riesgos de extinción (Squeo et al. 2001b, Letelier et al. 2008). De interés especial es la flora terrestre de las islas Chañaral, Damas y Choros, con 58 especies de las cuales 12 tiene su límite norte o sur de distribución en estas islas (Arancio & Jara 2007). En cuanto a la fauna terrestre, es importante mencionar los hallazgos y descripción recientes de una especie de coleóptero endémica de la isla Choros (Pizarro-Araya et al. 2012) y un roedor endémico de las dunas de Punta de Choros (Spotorno et al. 2013), siendo consideradas ambas como especies en peligro dado su alto endemismo y bajo número poblacional.

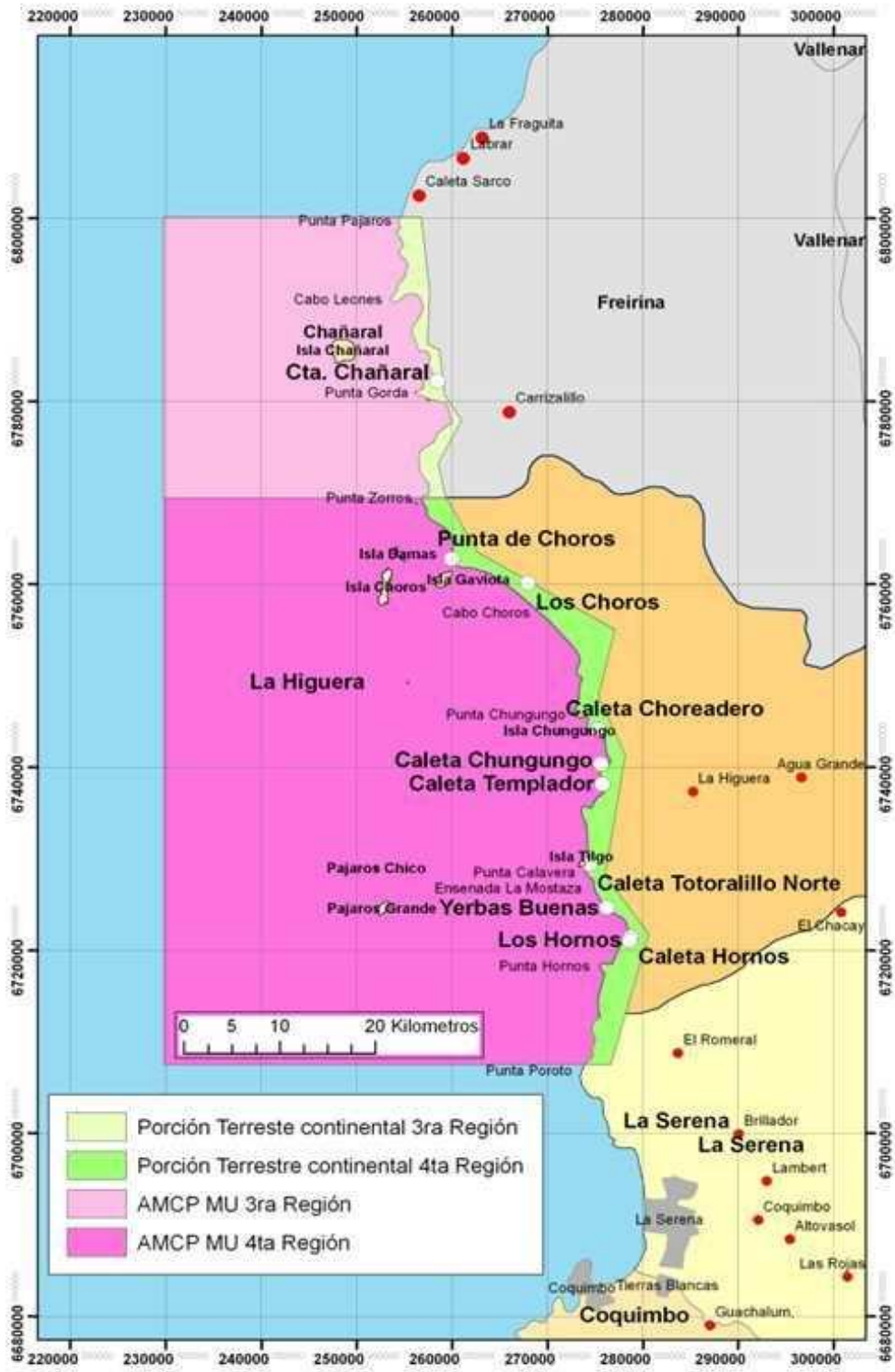

Fig. 1.2. Mapa del área propuesta para AMCP-MU La Higuera-Isla Chañaral (Oceana, 2010).

1.3.2. Ecosistema social

Los asentamientos humanos en esta área están limitados a pequeños poblados como Punta de Choros, Caleta Chungungo, Caleta Totoralillo Norte, Caleta Hornos y Caleta Chañaral, todos asociados a comunidades de pescadores (Fig. 1.3). Numerosas Áreas de Manejo y Explotación de Recursos Bentónicos (AMERBs) se encuentran en el sector de Punta de Choros y sus alrededores (Fig. 1.3), constituyendo la principal fuente de trabajo de las comunidades de pescadores artesanales existentes (González et al. 2006, Aburto et al. 2009).

Históricamente, la pesca artesanal ha sido la principal fuente de sustento para los habitantes del área, sin embargo en los últimos años, el área ha experimentado un auge turístico y numerosos pescadores (principalmente de Punta de Choros y Chañaral de Aceituno) han incursionado en actividades turísticas utilizando sus botes para el avistamiento de aves y mamíferos marinos, paseos marítimos alrededor de las islas y desembarque en la Isla Damas (Gaymer et al. 2008, Pavez et al. 2011).

1.3.3. Iniciativas de conservación, manejo y explotación en el área

Las características productivas, ecológicas y de biodiversidad del área han propiciado la declaratoria de varias figuras de protección de la biodiversidad y de explotación y manejo de recursos naturales. En el área se han establecidos las reservas marinas Islas Choros-Damas e Isla Chañaral (RMs), ubicadas en las comunas de La Higuera y Freirina, respectivamente (Fig. 1.3). Estas reservas fueron declaradas el año 2005 dadas su extraordinaria biodiversidad y productividad pesqueras (CONAMA 2008). La RM Islas Choros-Damas comprende el espacio

marítimo de 1 milla náutica en torno a la isla Choros (29°17’S; 71°32’W) e isla Damas (29°14’S; 71°31’W) abarcando una superficie total de 2.500 ha. La RM Isla Chañaral comprende el espacio marítimo de 1 milla náutica en torno a la isla Chañaral (29°01'S; 71°35'W) con una superficie total de 425 ha. Ambas constituyen el 40% de la superficie de AMPs en el centro-norte de Chile y presentan comunidades ecológicas importantes y representativas de la zona de transición del Sistema de la Corriente de Humboldt, la cual presenta un nivel de protección muy bajo (Guarderas et al. 2008). Ambas reservas son administradas por el Servicio Nacional de Pesca (SERNAPESCA) y tienen por objeto conservar y proteger los ambientes marinos representativos de los sistemas insulares, asegurando el equilibrio y la continuidad de los procesos bio-ecológicos a través del manejo y uso sustentable de la biodiversidad y el patrimonio natural (Subpesca 2005a, b). Entre las especies objetivo se encuentran algunas de importancia comercial como el loco *C. concholepas*, el erizo *Loxechinus albus* y las lapas *Fissurella latimarginata* y *Fissurella cumingi*, especies estructuradoras de hábitat como los huiros *L. trabeculata, L. spicata* y *L. berteroana*, y algunas especies emblemáticas como el pingüino de Humboldt *S. humboldti*, el chungungo *L. felina* y el delfín nariz de botella *T. truncatus*.

En su porción terrestre, las islas Damas, Choros y Chañaral constituyen la Reserva Nacional Pingüino de Humboldt (RNPH) de 859 ha (Fig. 1.3), decretada el año 1990 y administrada por la Corporación Nacional Forestal (CONAF). Esta reserva pertenece al Sistema Nacional de Áreas Silvestres Protegidas por el Estado (SNASPE) y fue creada en 1990, fundamentada principalmente en la alta abundancia de pingüinos de Humboldt y en la presencia de la formación vegetal denominada Desierto Costero de Huasco (CONAMA 2008). Isla Gaviota (182 ha), ubicada entre isla Choros y el continente, fue decretada el año 2006 como bien

nacional protegido dependiente del Ministerio de Bienes Nacionales, pero no tiene protección efectiva o plan de manejo.

En la parte terrestre continental se han definido dos sitios prioritarios para la conservación de la flora nativa con riesgos de extinción: Cerro Juan Soldado en la Región de Coquimbo (Squeo et al. 2001a) y Carrizalillo en la Región de Atacama (Squeo et al. 2008) (Fig. 1.3).

En el año 2009, gran parte de la costa e islas del área de estudio fueron determinadas como sitio prioritario para la conservación, tanto por SERNAPESCA como por CONAF. En el año 2010, y fundamentado en las características particulares de esta área, en su porción marina, costera y terrestre, respecto a diversidad, representatividad y exclusividad de especies y hábitat, los usos humanos actuales y potenciales, las características socio-económicas de las comunidades locales y las amenazas e impactos a la salud ecosistémica, la ONG Oceana propuso al Gobierno de Chile esta área como AMCP-MU (Oceana 2010). Estudios realizados por Squeo et al. (2010, 2012) confirman la importancia de esta área como parte de un portafolio de conservación nacional que permitiría cumplir con las metas de conservar el 10 % de los ecosistemas naturales de Chile.

En el área se encuentran 12 AMERBs que explotan principalmente locos y lapas. Incluso existe una AMERB que es rodeada por la RM Isla Choros-Damas (Fig. 1.3). Esta AMERB fue solicitada por la asociación de pescadores de Punta de Choros y otorgada casi simultáneamente con la declaración de la RM. Es importante destacar también, la extracción de algas pardas desde las AMERBs y desde Áreas de Libre Acceso (ALA) llevada a cabo principalmente por recolectores de orilla, que si bien no contribuye de manera significativa al desembarque regional (Chávez & Tirado 2008), es la principal fuente de ingresos económicos para familias con alto riesgo social (Vásquez 2008). El área está dentro de la zona de pesca de

langostinos (*Cervimunida johni* y *Pleuroncodes monodon*) y camarón nylon (*Heterocarpus reedi*) (Mujica et al. 2011) existiendo autorizaciones (Subsecretaría de Pesca) para realizar perforaciones en la zona de 5 millas náuticas reservada para la pesca artesanal.

Respecto a otros usos asociados a la costa, es importante destacar tres proyectos de centrales termoeléctricas a carbón en el área (Fig. 1.3) que fueron desistidos en medio de un conflicto social y controversias respecto a su ubicación y compatibilidad con los usos y objetivos de conservación existentes en el área (Cárcamo et al. 2011). En la actualidad, están proyectados dos megapuertos (Totoralillo Norte y Chungungo) asociados principalmente a la exportación de recursos mineros[2].

[2] Uno de los proyectos se encuentra en proceso de evaluación ambiental (http://www.sea.gob.cl) e incluye una propuesta de área protegida privada terrestre.

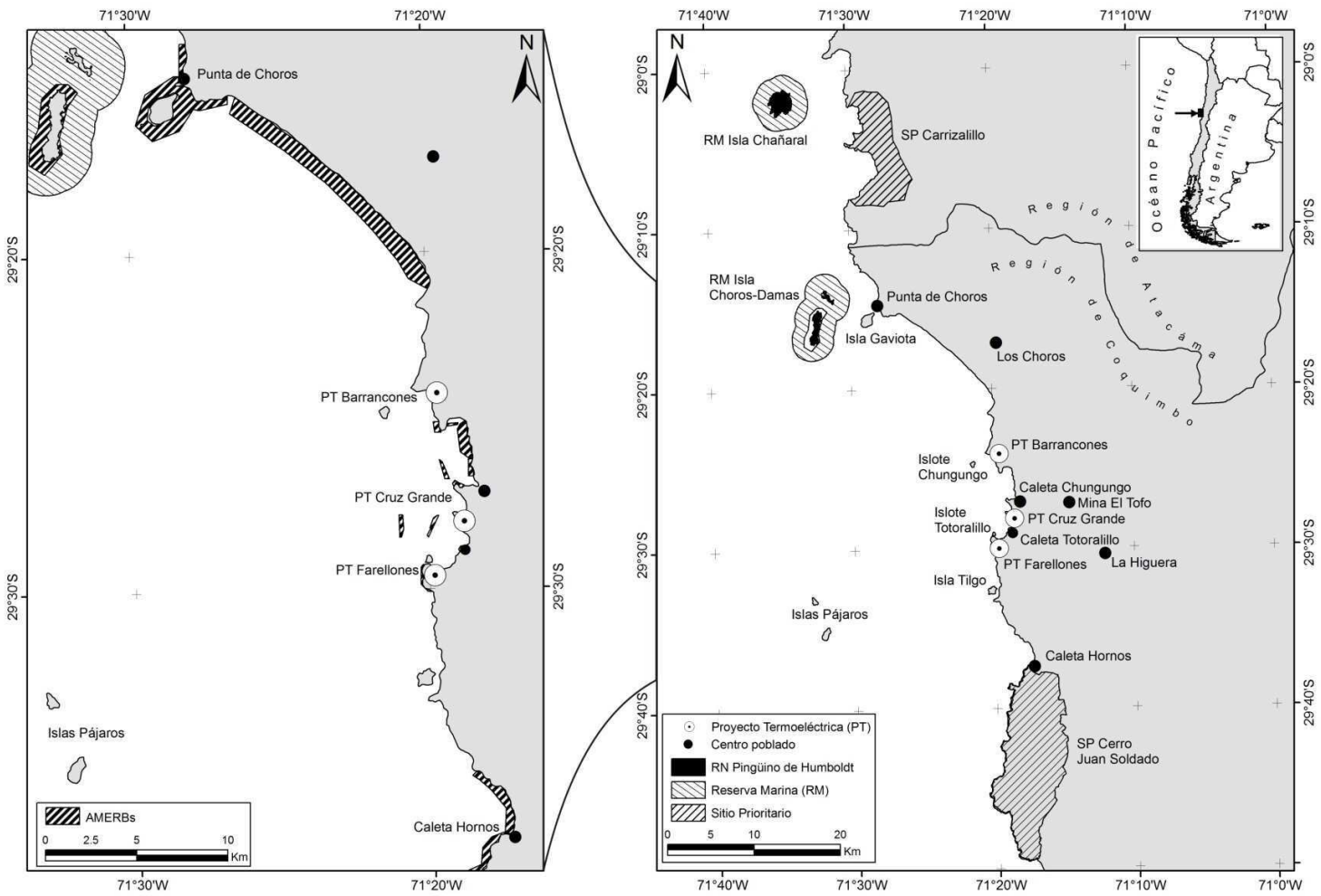

Fig. 1.3. Área de estudio. Ubicación de reservas marinas, reserva terrestre, sitios prioritarios, poblados y proyectos de termoeléctricas. Tomada de Cárcamo et al. (2011).

1.4. Objetivos de la tesis

La gran pregunta de investigación que orienta esta tesis es cómo avanzar hacia un nuevo enfoque para la planificación, manejo y gobernanza de las costas chilenas, teniendo como eje central la conservación de la biodiversidad y considerando las particularidades y complejidades de los sistemas socio-ecológicos de soporte. Para ello, se utiliza el AMCP-MU como oportunidad para aplicar un MBE y como herramienta para la conservación de la biodiversidad. Sobre la base de la pregunta de investigación, se desprende el siguiente objetivo general: desarrollar una estrategia de MBE para el Área Marina Costera Protegida de Múltiples Usos La Higuera-Isla Chañaral. Para avanzar hacia el desarrollo de la estrategia esta tesis plantea los siguientes objetivos específicos:

Objetivo 1. Analizar el funcionamiento de las actuales medidas de conservación y manejo existentes en el área del AMCP-MU, identificando así, los desafíos de manejo y gobernanza.

Objetivo 2. Analizar el actual escenario legal e institucional para la implementación de iniciativas de MBE en el área del AMCP-MU y en Chile.

Objetivo 3. Analizar los actores de interés para la toma de decisiones respecto a manejo de recursos naturales en el área del AMCP-MU.

Objetivo 4. Comparar entre los diferentes grupos de interés, la identificación y valoración de usos, características de biodiversidad, servicios ecosistémicos y amenazas a su provisión en el área del AMCP-MU.

Objetivo 5. Identificar características de biodiversidad, servicios ecosistémicos y usos claves para la planificación del AMCP-MU.

Objetivo 6. Definir aspectos claves para construir una estrategia de manejo para el AMCP-MU basada en los principios del MBE.

Gran parte del desarrollo del presente proyecto de tesis correspondió a investigación exploratoria y descriptiva, no siendo estrictamente necesario el planteamiento de hipótesis (Hernández-Sampieri et al. 2006). Sin embargo, para el desarrollo del objetivo específico 4, se plantearon dos hipótesis de trabajo asociadas a la importancia de la escala espacial en la percepción e intensidad de valoración, por parte de actores de interés, de un bien o problema ambiental (Norton & Hannon 1997, Newig & Fritsch 2009):

-La valoración de usos, biodiversidad, servicios ecosistémicos y amenazas a su provisión, por parte de los diversos grupos de interés, estará fuertemente influenciada por el contexto socio-económico y espacial en el cual un determinado actor de interés (*stakeholders*) se relaciona con los diferentes componentes ecosistémicos naturales.

-La valoración de usos, biodiversidad, servicios ecosistémicos y amenazas a su provisión, por parte de actores de interés (*stakeholders*) que viven más próximos a los diferentes componentes ecosistémicos naturales, estará asociada al uso económico o explotación de éstos.

1.5. Enfoque metodológico de investigación

Cualquier estrategia de manejo participativo y colaborativa como el MBE requiere de un proceso de toma de decisiones flexible y transparente que incluya la diversidad de conocimientos y valores existentes en un determinado sistema socio-ecológico (Ostrom 1990, Folke et al. 2005, Armitage et al. 2008, McLeod & Leslie 2009). Es indudable que el conocimiento biológico y ecológico en solitario no es suficiente para resolver los problemas de planificación de la conservación y manejo de recursos naturales. En este sentido, investigaciones sobre las dimensiones sociales son fundamentales para informar iniciativas de planificación y manejo basadas en ecosistemas o en el lugar (Mascia et al. 2003, Fox et al. 2006, Koehn et al. 2013). Las acciones de conservación y manejo son finalmente reflejo de las conductas humanas y por lo tanto, es vital comprender cómo diferentes factores socio-económicos y culturales condicionan las interacciones humano-ambiente y las diferentes alternativas para explotar, manejar o conservar la biodiversidad. En este sentido, el AMCP-MU La Higuera-Isla Chañaral es considerado como un sistema socio-ecológico y esta tesis enfatiza la importancia de las dimensiones sociales en su planificación. Por lo tanto, esta investigación se orienta hacia un trabajo integrado de diversos métodos y técnicas provenientes de disciplinas como el manejo de recursos naturales, la biología de la conservación y de las ciencias sociales. Una enumeración de las técnicas utilizadas en esta tesis se entrega en la Tabla 1.1 y el detalle de éstas, en el desarrollo de los respectivos capítulos.

Tabla 1.1. Capítulos de la tesis, objetivos asociados y métodos asociados.

Capítulo	Objetivo(s) general(s) del capítulo	Obj. específico asociado	Métodos/técnicas	Enfoque analítico
1	- Proporcionar marco teórico y contexto de la tesis - Proporcionar justificación de la tesis, objetivos y marco metodológico	1, 2, 3 ,4 , 5 , 6	-Revisión de literatura -Revisión de documentos	-Análisis de contenido
2	- Analizar interacciones ecológicas e institucionales entre sistemas gobernante (e.g., AMP) y ecosistemas natural y social - Identificar los desafíos de manejo y gobernanza para el área del AMCP-MU	1	-Caso de estudio -Entrevista semi-estructurada -Encuesta	-Análisis de gobernanza con enfoque de sistemas -Análisis temático -Análisis estadístico descriptivo
3	-Analizar el ajuste y vacíos legal e institucional para implementar MBE en el área del AMCP-MU -Evaluar medidas e instrumentos existentes en la legislación chilena y su potencial pata implementar MBE	2	-Método analítico cuantitativo de co-ocurrencia -Modelo conceptual -Revisión de literatura y casos -Revisión de documentos	-Análisis de contenidos -Análisis de vacío y ajuste -Análisis relacional -Análisis de contenido
4	-Explorar redes sociales de colaboración e intercambio de información en torno al uso de recursos naturales en el área del AMCP-MU -Identificar actores claves para la implementación del AMCP-MU	3	-Cuestionario actores claves	-Análisis de redes sociales -Matriz influencia-capacidad -Análisis estadísticos inter-grupales
5	-Investigar valoración de servicios ecosistémicos, biodiversidad, usos y amenazas en el área del AMCP-MU -Investigar expectativas de actores de interés sobre el funcionamiento del AMCP-MU -Generar un modelo conceptual para relacionar priorizaciones de componentes ambientales	4,5	-Cuestionario actores claves -Modelo conceptual -Recopilación información biofísica	-Valoración ambiental -Análisis estadísticos inter-grupales -Análisis estadístico no paramétrico multivariado -Análisis de redes
6	-Proponer elementos y pasos claves para el desarrollo de una estrategia de implementación de MBE para el AMCP-MU	6	-Revisión de literatura -Revisión resultados de la tesis	-Análisis de contenido
7	-Resumir conclusiones y aportes de la tesis	6	-Revisión resultados de la tesis	-Análisis de contenido

1.6. Estructura de la tesis

Esta tesis está estructurada en siete capítulos dispuestos en cuatro partes (Tabla 1.1). La **Primera Parte** comprende el *Capítulo 1*, introductorio de la tesis incluyendo el marco teórico sobre manejos colaborativos en recursos naturales, definición e implementación de MBE, AMPs en el contexto del MBE, así como también, estos mismos tópicos en el contexto nacional. Además, incluye la fundamentación, objetivos e hipótesis de esta tesis.

La **Segunda Parte** incluye los *Capítulos 2* y *3*, correspondiendo en general, a un diagnóstico de gobernanza y manejo existente en el área del AMCP-MU, así como también de las posibilidades que ofrece el marco legal e institucional nacional para el desarrollo e implementación del MBE. El *Capítulo 2* analiza el funcionamiento y desafíos de gobernanza para el área del AMCP-MU bajo el marco de gobernanza para AMPs propuesto por Jentoft et al. (2007) que reconoce la importancia de considerar las relaciones e interacciones entre el sistema gobernante (social), el sistema a gobernar (natural y social) y el sistema socio-ecológico más amplio que los soporta. Primero, este capítulo presenta una breve descripción de la conservación marina en Chile. En segundo lugar, describe la RM Isla Choros-Damas (sistema gobernante), incluyendo los procesos de creación, implementación y operación, y la descripción del ecosistema natural y social. En tercer lugar, se analizan las interacciones y las relaciones entre la reserva marina y otras medidas de manejo y conservación espacialmente explícitas existentes en el área incluyendo los procesos ecológicos, las amenazas, las interacciones socio-económicas y las interacciones institucionales que afectan los resultados de manejo y gobernanza del área. Por último, se discute las implicancias de los resultados para la gobernanza del área y el cumplimiento de los objetivos y metas de conservación. El

Capítulo 3 explora el ajuste institucional potencial en un escenario hipotético de aplicación de MBE en el área del AMCP-MU. Posteriormente, se evalúan diferentes instrumentos de manejo, conservación y planificación asociados a recursos marinos y costeros que existen en la legislación chilena en cuanto a su aptitud para la implementación del MBE. Finalmente, se discute las posibilidades a corto plazo de la aplicación de MBE en las costas chilenas.

La **Tercera Parte** incluye los *Capítulos 4* y *5*, correspondiendo a levantamiento de información en terreno para estudiar los actores de interés del área en cuanto a su organización y dinámica en torno al uso de recursos naturales y en cuanto a sus percepciones de diversos componentes ambientales para planificar el AMCP-MU. El *Capítulo 4* investiga la estructura y propiedades de las redes sociales inter-organizacionales asociadas al uso y manejo de recursos naturales en el área del AMCP-MU. Se exploran dos configuraciones de redes: relaciones de colaboración y relaciones de transferencia e intercambio de conocimientos e información científica respecto al uso de recursos naturales. Luego de describir cómo las organizaciones se conectan entre sí (e.g., estructura de la red completa, grupos, posiciones y roles), se analiza el potencial de estas redes para apoyar la implementación y operación del AMCP-MU. Además, para contrastar con los resultados de análisis de redes, se realizó un análisis de actores utilizando su influencia y capacidad como variables para identificar y clasificar actores para la planificación e implementación del AMCP-MU. Finalmente, se discute el valor y la aplicabilidad del análisis de actores en el contexto de gobernanza y manejo de recursos naturales en zonas costeras. El *Capítulo 5* investiga: i) las percepciones de los actores de interés sobre identificación y valoración de servicios ecosistémicos y las amenazas a su provisión; ii) las percepciones de los actores de interés sobre la priorización de servicios ecosistémicos, características de diversidad biológica y usos humanos en un

escenario de planificación para el AMCP-MU; iii) las expectativas de los actores de interés respecto al establecimiento del AMCP-MU; y iv) las relaciones entre las priorizaciones y entre las percepciones de los diferentes grupos de actores de interés. Luego, para relacionar los diferentes componentes valorados se propone un modelo conceptual simple que reduce la complejidad ambiental y permite la comunicación de resultados de planificación de una manera fácil y accesible. Finalmente, se discute el valor y la aplicabilidad de la inclusión de las percepciones de los actores de interés en el contexto de la planificación de las AMPs y MBE para las zonas costeras.

La **Cuarta Parte** incluye los *Capítulos 6* y *7*, correspondiendo a una etapa de síntesis y discusión de resultados. El *Capítulo 6* describe una propuesta de lineamientos y elementos claves para el desarrollo de una estrategia de MBE para el AMCP-MU basado en el análisis de los resultados de la presente tesis y revisión de literatura y casos de estudio. Finalmente, el *Capítulo 7* describe las principales conclusiones de la tesis y las posibilidades de aplicación de los resultados.

Capítulo 2. Interactions between spatially explicit conservation and management measures: implications for the governance of marine protected areas[3]

[3]Cárcamo, P.F., Gaymer, C.F. 2013. Interactions between spatially explicit conservation and management measures: implications for the governance of marine protected areas. Environmental Management 52: 1355-1368.

2.1. Abstract

Marine protected areas are not established in an institutional and governance vacuum and managers should pay attention to the wider social–ecological system in which they are immersed. This article examines Islas Choros-Damas Marine Reserve, a small marine protected area located in a highly productive and biologically diverse coastal marine ecosystem in northern Chile, and the interactions between human, institutional, and ecological dimensions beyond those existing within its boundaries.Through documents analysis, surveys, and interviews, we described marine reserve implementation (governing system) and the social and natural ecosystem-to-be-governed. We analyzed the interactions and the connections between the marine reserve and other spatially explicit conservation and/or management measures existing in the area and influencing management outcomes and governance. A topdown approach with poor stakeholder involvement characterized the implementation process. The marine reserve is highly connected with other spatially explicit measures and with a wider social–ecological system through various ecological processes and socio-economic interactions. Current institutional interactions with positive effects on the management and governance are scarce, although several potential interactions may be developed. For the study area, any management action must recognize interferences from outside conditions and consider some of them (e.g., ecotourism management) as cross-cutting actions for the entire social–ecological system. We consider that institutional interactions and the development of social networks are opportunities to any collective effort aiming to improve governance of Islas Choros-Damas marine reserve. Communication of connections and interactions between marine protected areas and the wider social–ecological system (as

described in this study) is proposed as a strategy to improve stakeholder participation in Chilean marine protected areas.

2.2. Introduction

Marine Protected Areas (MPAs) are spatially explicit conservation measures that have been used as tools for fisheries management and/or biodiversity conservation (Roberts et al. 2005, Gaines et al. 2010). MPAs have been implemented in different forms, depending, for example, on the desired level of restriction and the regulation of their uses, the legal and institutional framework in the region or country and conservation goals. This variety of implementation approaches has led to references to these by different nomenclature (e.g., no-take marine reserves), which can often be confusing and can create unrealistic expectations regarding the level of and reasons for protection (Al-Abdulrazzak & Trombulak 2012).

Recent reviews of MPAs with strong fishing restrictions show positive effects on the biomass, density, species richness, and size of organisms within them (Lester et al. 2009). Areas outside the protected areas have also witnessed benefits, such as for artisanal fisheries, as a product of spillover (Goñi et al. 2010). Also, MPAs promote productive non-extractive activities like ecotourism, playing an important role in diversifying the local economy (e.g., fishermen) (Oracion et al. 2005, Charles & Wilson 2009).

There is a consensus that the planning, implementation, and management of an MPA should be based not only on knowledge of the physical and ecological systems that affect it but also on the human dimensions, including governance-related, socio-economic, institutional, and cultural aspects (Charles & Wilson 2009). Ultimately, these dimensions facilitate or hinder the

implementation of an MPA (Rodríguez-Martínez 2008, Pollnac et al. 2010). Historically, the processes involved in both the creation and governance of MPAs can range from highly centralized initiatives in which the state is the advocate and acts as the exclusive governor to initiatives based in local communities (Hind et al. 2010).

MPAs can affect or be affected by other conservation measures or ecosystems through ecological processes (e.g., land-sea interactions), anthropogenic threats (e.g., pollution), and socio-economic interactions associated with management decisions (e.g., displacement of fishermen) (Mascia et al. 2010, Álvarez-Romero et al. 2011). From a governance perspective, Jentoft et al. (2007) noted that an MPA should be studied as a system or as a system of and within systems. These authors suggest that MPAs are comprised of three open and interactive systems: i) a governing system consisting of institutions and governing mechanisms, ii) the system-to-be-governed, with both natural and social aspects, consisting of an ecosystem and its resources, as well as a system of users and stakeholders that form political institutions and coalitions, and iii) a third system constituted by the relationship and interaction of MPAs with the wider social-ecological system in which they are immersed. This third interactive system indicates that MPAs are not established in a vacuum (in terms of institutional and governance arrangements) (Olsson et al. 2008), cannot be managed in isolation (Jentoft et al. 2007), and the connections and interactions (at the same or different organizational levels) among different institutional arrangements can significantly affect the effectiveness of MPAs (Grilo 2011). Indeed, Agardy et al. (2011) hold that a number of MPAs do not achieve their goals due to degradation of unprotected surrounding areas. Using a small MPA (Islas Choros-Damas Marine Reserve; hereafter ICHD-Marine Reserve) located in a highly productive and biologically diverse coastal marine ecosystem in northern Chile as study case, with attractive

natural features for doing ecotourism, and the establishment of which coincided with other spatially explicit conservation and/or management measures (hereafter SECMMs), the aim of this paper was to analyze the performance and governance challenges of ICHD-Marine Reserve, recognizing the importance of considering the inter-linkages between the social governing system, the system-to-be-governed, and the wider social–ecological system (Jentoft et al. 2007), especially relevant in a country like Chile, with severe problems of MPAs coverage (Squeo et al. 2012) and where much of the coast has been and is being allocated for fishing and aquaculture purposes. First, to understand the context of Chilean MPAs establishment we provide a brief overview of marine conservation in Chile. Second, we describe the marine reserve (i.e., governing system), including creation, implementation, and operation processes, and the social and natural ecosystem (i.e., system-to-be-governed). Third, we analyzed the interactions and the connections between the marine reserve and other SECMMs, including ecological processes, threats, and socio-economic interactions resulting from management decisions, and the institutional interactions influencing management outcomes and governance of the area. Finally, we discuss the implications of interactions between systems for the governance of the area and its compliance with conservation goals.

2.3. Overview of coastal marine conservation in Chile

Unlike terrestrial environments, the conservation measures applied to marine and coastal areas in Chile are recent. Chile has several problems with MPA coverage and their ecological representativeness, which keeps it far from achieving CBD conservation targets (Squeo et al. 2012). In addition, funding for conservation measures is scarce despite the high levels of

threatened biodiversity (Waldron et al. 2013). At present, there are 15 MPAs in Chile, covering a total area of 15,080,657 ha, equivalent to 4.1% of the Chilean Exclusive Economic Zone. However, only the Motu Motiro Hiva Marine Park, which is located at 410 km northeast of Easter Island, contributes with 99.5 % of the whole protected area. There are various legal spatially explicit conservation and/or management measures (SECMMs) with coastal or marine components (Table 2.1), though the measures that are truly dedicated to coastal marine conservation (i.e., MPAs) are marine reserves, marine parks, marine coastal protected areas, and multiple-use coastal marine protected areas.

The Chilean Fisheries and Aquaculture General Law (hereafter Fisheries Law) is the main legal framework for the management and development of the aquatic environments, and it defines a number of management measures for the sustainable use and conservation of hydrobiological resources. Among them, two types of spatially explicit conservation measures are marine reserves and marine parks. Marine reserves safeguard areas of hydrobiological resources to protect spawning and fishing grounds, and restocking areas through management, and are under the enforcement of the National Fisheries Service. Extractive activities can be carried out during temporary periods and by prior authorization by the Undersecretary of Fisheries. There are five marine reserves in Chile and only two include the sustainable use of biodiversity and natural heritage among their original goals, ICHD-Marine Reserve being one of them. Other measure of spatially explicit fisheries management present in the Fisheries Law are the Management and Exploitation Areas for Benthic Resources (hereafter Management Areas), corresponding to delimited marine territorial areas for the exclusive use of legally constituted organizations of artisanal fishermen that allocates exclusive fishing rights for particular species defined by fishermen and subjected to the approval of a management plan

by the Undersecretary of Fisheries. Chilean MPAs are established and managed under different legal frameworks and the governance systems include different agencies responsible for planning, management, and enforcement (Table 2.1). Problems of funding, inter-agency coordination, and role and function overlapping between government agencies could be corrected with the creation of the Biodiversity and Protected Areas Service responsible for administering all protected areas (Law proposal currently discussing in the Chilean Congress; Squeo et al. 2012).

2.4. Description of the study area

Punta de Choros is a small village of 332 inhabitants founded in 1991 around a fishing settlement (Municipality of La Higuera, Coquimbo Region, 29°14'47" S; 71°28'06" W). The ICHD-Marine Reserve and other adjacent SECMMs are located in the area (Fig. 2.1). This area belongs to an ecosystem that is representative of the temperate transitional region of the Humboldt Current System (Thiel et al. 2007). The high fishery productivity, as well as the unique biodiversity and ecological characteristics of the area, makes this area interesting both for fishing and conservation (Thiel et al. 2007, Luna-Jorquera et al. 2012). Within the terrestrial environment, there is a high diversity of native vascular plants, a large percentage of which are endemic to Chile and a smaller percentage that are endemic to the region (Squeo et al. 2001b).

The islands system in the area provides the nesting and feeding sites for important seabird populations, many of which are endemic to the Humboldt Current and have conservation problems (Simeone et al. 2003, Luna-Jorquera et al. 2012). This system also represents the

habitat of several permanent and seasonal populations of mammals and seabirds (Pérez et al. 2006, Thiel et al. 2007). For instance, this area supports the largest colony of Humboldt Penguin in the world (Mattern et al. 2004). Among the region's benthic communities, the kelp forests harbor a great diversity of marine organisms (Gaymer et al. 2008). This system also corresponds to one of the areas with the highest productivity of benthic fisheries in the region, primarily involving the harvesting of the whelk *Concholepas concholepas* (Thiel et al. 2007).

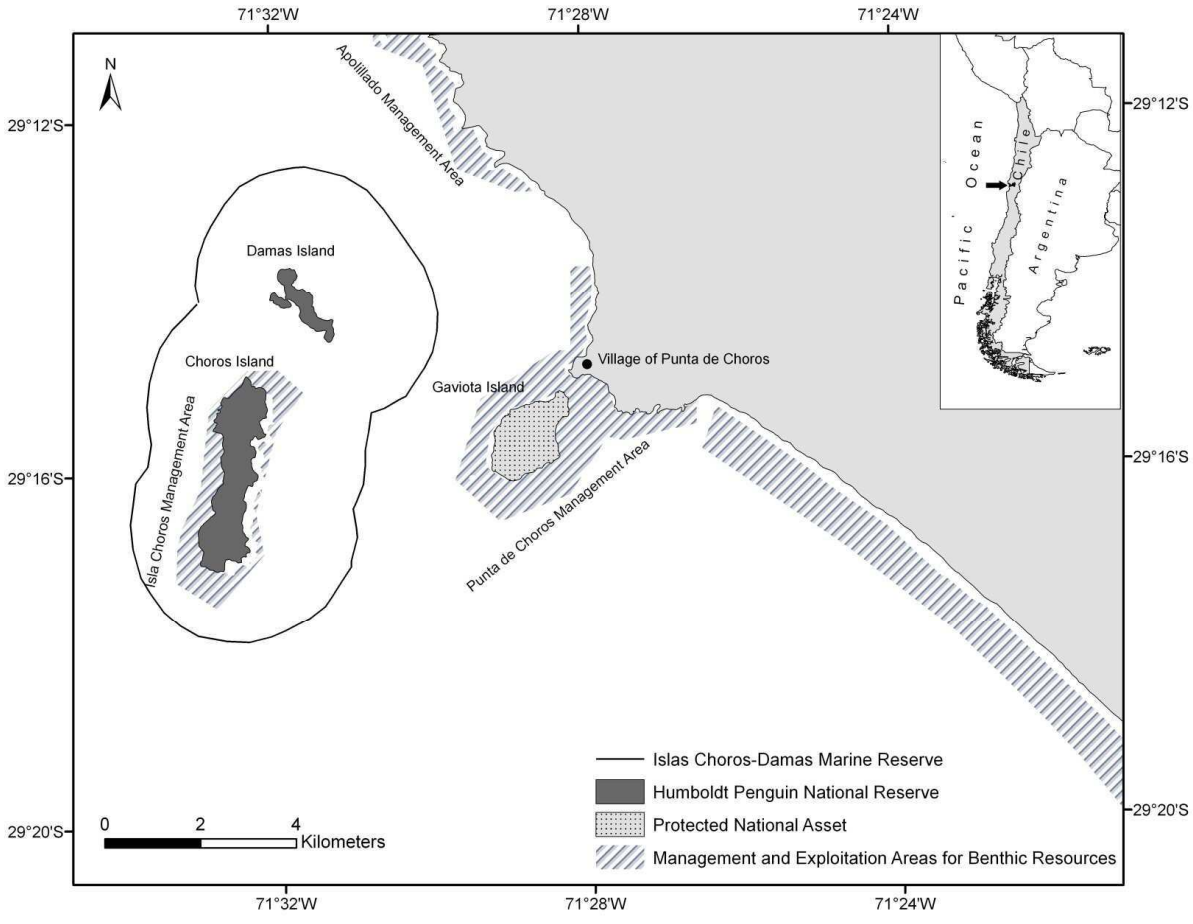

Fig. 2.1. Punta de Choros study area, indicating the different spatially explicit conservation and/or management measures.

Table 2.1. Principal spatially explicit conservation and/or management measures in Chilean legislation with marine or coastal components.

Name	Principal regulatory framework	Governance Modes	Primary management tool	Goal
Marine Reserve*	Fisheries Law	State (National Fisheries Service)	General Administration Plan	Protection of areas of hydrobiological resources to protect spawning and fishing grounds and restocking areas through management
Marine Park	Fisheries Law	State (National Fisheries Service)	General Administration Plan	Preservation of ecological units of interest for either science or protect areas to ensure the maintenance and diversity of hydrobiological species, as well as those associated with their habitats
Management and Exploitation Areas for Benthic Resources*	Fisheries Law	Co-management (Fishermen and Undersecretary of Fisheries)	Management and Exploitation Plan	Management and use of benthic resources by fishermen
Marine Coastal Protected Areas	Maritime Concessions Law	Private (e.g., Universities)	Administration Plan	Development of scientific research
Multiple-use Coastal Marine Protected Areas*	Maritime Concessions Law National Assets Law	Public-private	Administration Plan	Conservation of biodiversity and cultural heritage, reduce user conflicts, promote research and develop commercial and recreational activities with a low environmental impact
National Reserve*	Forest Law National System of Protected Wildlife Areas Washington Convention	State (National Forestry Corporation)	Management Plan	Conservation and protection of soil resources and endangered species of fauna and flora
National Protected Asset*	National Assets Law	State (Ministry of National Assets)	Zoning	Environmental conservation and protection, planning and management of biodiversity heritage

*Measures referred in this study

2.5. Methodology

We divided our analysis in three main sections. *First,* a description of the governing system (i.e., ICHD-Marine Reserve) based on revision of official documents related to ICHD-Marine Reserve (official perspective) and interviews with key stakeholders (stakeholder's perspective). Documents reviewed included laws, decrees, regulations, planning instruments, workshops proceedings, and monitoring reports (see Annex 2.1). *Creation*, *implementation*, and *effectiveness* were the dimensions considered in the revision. For *creation*, we considered the political and institutional context in which the marine reserve arises; for *implementation*, operational and institutional aspects and the governance structure[4] and stakeholder participation[5] were revised; and for *effectiveness*, the effectiveness of ICHD-Marine Reserve according to their goals and targets was evaluated. To obtain information from the fishermen's perspective (i.e., group most affected by the ICHD-Marine Reserve implementation) and supplement the three dimensions, we conducted semi-structured interviews with six fishing leaders belong to fishermen´s organizations that have historically fished in the study area (Aburto et al. 2009) (three from Punta de Choros and three from villages in the southern part of the commune). The interviews were carried out between November 2011 and April 2012 and then analyzed using a grounded theory approach (Glaser & Strauss 1967). Interviews were audio recorded and transcribed and responses were coded by assigning data to different domains and emerging categories for subsequent interpretation (Miles & Huberman 1994). In Table 2.2 we provide a semi-structured interview guide.

[4]Corresponds to structures and processes that provide the social and institutional context in which SECMMs operate.
[5]The range of individuals or groups involved, interested or affected by the decision.

Second, a description of the system-to-be-governed (i.e., natural and social ecosystem of the Punta de Choros area), including a brief characterization of tourism in the study area. To explore issues related to tourism development in the study area, surveys were conducted during February 2012 (the month with greatest number of visitors), in which a sample of 50 randomly selected tourists visiting Punta de Choros and the surrounding islands participated. We designed and conducted the survey as a closed questions questionnaire. The survey involved questions concerning the interviewee's knowledge of the region and protected areas, their reasons for visiting, and their assessment of their visit (Table 2.2). Data associated with tourism trade was also collected *in situ* in February 2012.

Third, an analysis of the relationships and interactions between ICHD-Marine Reserve and the wider social-ecological system in which is immersed. For this, we analyzed the interactions and the connections between ICHD-Marine Reserve and other SECMMs existing in the Punta de Choros area, considering the *connections* among systems and the *institutional interactions*[6]. We performed a text analysis of the collection of official documents, which is a type of content analysis (Krippendorff 2004) that mainly uses phrases to encode written material. For the *connections* among systems, we looked for ecological processes, threats, and socio-economic interactions resulting from management decisions; and for the *institutional interactions* among SECMMs, we looked for explicit aspects and potential interactions such as institutional collaboration networks, overlap, complementarities, and conflicts. Also, these dimensions were supplemented with the analysis of interviews to fishermen.

[6]Corresponds to situations where the performance of one institution is significantly affected by the operation or consequences of another (Grilo 2011). In turn, institutions are prescriptions that humans use to organize all forms of repetitive and structured interactions (Ostrom 2005). This broad definition would include fishermen's organizations, government agencies and MPAs as institutions among others.

2.6. Results

2.6.1. ICHD-Marine Reserve: the governing system

In 2005, the Undersecretary of Fisheries led the process of creating a marine reserve around Choros and Damas Islands. The same year, the Isla Choros Management Area (Fig. 2.1) was requested by the Punta de Choros Fishermen's Association and its area was excluded from the marine reserve (Table 2.3). Both measures were negotiated primarily with the Punta de Choros Fishermen's Association. The Punta de Choros Fishermen's Association feels part of the process of creating the ICHD-Marine Reserve, unlike the Los Choros Fishermen's Association and fishermen from the southern part of the municipality (Table 2.4). The effective implementation of the ICHD-Marine Reserve has been a slower process, for example, the environmental permit to put the management plan into action was only recently obtained (i.e., 2011) by National Fisheries Service from the Environmental Ministry. The marine reserves regulation promotes stakeholder participation in the development and monitoring of the management plan but neither this regulation nor any other decree acknowledges the formation of more organized support or consultation for the marine reserves. However, in 2007, a working group was formed including local, municipal and regional stakeholders who have supported the implementation of the ICHD-Marine Reserve. Putting the ICHD-Marine Reserve into place has generated conflicts, mainly between fishermen's organizations, because both the ICHD-Marine Reserve and the Isla Choros Management Area traditionally corresponded to open access fishing areas, where fishermen from southern part of the municipality fished for several decades (Table 2.4).

The ICHD-Marine Reserve lacks permanent surveillance. National Fisheries Service has no official or permanent base in Punta de Choros, thus surveillance is only occasional. A number of violation notices have been issued to fishermen fishing within the ICHD-Marine Reserve. Although fishermen organizations have implemented surveillance systems incorporating most of the fishermen of the organization, to detect illegal fishing inside the Management Area (Table 2.4), the situation is complicated when we consider that at Choros Island, the ICHD-Marine Reserve surrounds the Isla Choros Management Area (Fig. 2.1).

To date, the ICHD-Marine Reserve effectiveness has not been assessed.

Table 2.2. Semi-structured interview guide for fishermen leaders and questions asked to tourists in the survey at the Punta de Choros study area.

Topics in interview
Use of marine and coastal resources in study area
Perceptions regarding creation and implementation of SECMMs
Participation in implementation and management of SECMMs
Experiences and perception regarding performance of SECMMs
Experiences and perception regarding tourism development in study area
Survey questions
How did you hear about Punta de Choros area?
What were the reasons for coming to Punta de Choros area?
What you saw on the boat tour around the islands?
What do you think is the most attractive aspect of Punta de Choros area?
Do you think that tourism can have negative impacts on wildlife of Punta de Choros area?
Before coming. Did you know of the existence of protected areas at the Punta de Choros area?

Table 2.3. Chronology of principal spatially explicit conservation and/or management measures in the Punta de Choros study area. MEABR= management and exploitation areas for benthic resources.

Year	Name	Management System	Area (ha)	Reason for decree
1990	Humboldt Penguin National Reserve	National Forestry Corporation	889	Protection of the Humboldt Penguin (*Spheniscus humboldti*) Low representativeness of vegetation in the coastal desert of SNASPE Area with great potential for scientific research, marine management, environmental education and recreation
1997	Apolillado MEABR	Los Choros Fishermen's Association + Undersecretary of Fisheries	237	Management and use of benthic resources by fishermen
1998	Punta de Choros MEABR	Punta de Choros Fishermen's Association + Undersecretary of Fisheries	907	Management and use of benthic resources by fishermen
2005	Isla Choros MEABR	Punta de Choros Fishermen's Association + Undersecretary of Fisheries	297	Management and use of benthic resources by fishermen
2005	Islas Choros-Damas Marine Reserve	National Fisheries Service	3834	To conserve community structure and its environmental value To maintain stocks of interest for artisanal fishing to enhance MEABRs yield To preserve and restore populations of benthic community structuring algae To protect dolphin (*Tursiops truncatus*), sea otter (*Lontra felina*) and penguin (*S. Humboldti*)
2006	Gaviota Island National Protected Asset	Ministry of National Assets	193	Conservation of biodiversity heritage

Table 2.4. Summary of analysis of interviews with fishermen. Responses by conceptual category. Numbers in parentheses indicate number of responses from a total of six respondents.

Domain	Category	Examples of quotations
Creation of SECMMs	Key stakeholders in Marine Reserve establishment process (2)	“Here is born ... thanks to fishermen, a Marine Reserve ... that will be able ... to contribute positively to other communities" *(Punta de Choros Fishermen’s Association Leader 1*)
Implementation of SECMMs and stakeholder participation	Positive perceptions about the implementation of Marine Reserve (3)	"We were not considered in the implementation of the Marine Reserve, however, we have not objected to its existence, as we believe it is best to conserve resources over time" (*Los Choros Fishermen’s Association Leader 1*)
	Negative perceptions about the implementation of Marine Reserve (3)	"We fishermen from southern La Higuera have always gone fishing at Choros, Damas and Gaviota Islands. In fact, we went with our families and camped for weeks on Damas Island. Many people went. We had a good time. We didn’t have any problems among the fishermen ... and then, first under the National Reserve, we were banned from camping on Damas Island, and then the Marine Reserve divided us fishermen ... now we cannot even get near the islands" (*Leader 1 fromsouthern La Higuera*) "Now, with the Marine Reserve, the only beneficiaries are the Punta de Choros Fishermen’s Association. They are the only ones who obtain economical benefits from tourism, not even those from Los Choros Fishermen’s Association" (*Leader 2 from southern La Higuera*)
	Conflicts between stakeholders (6)	"When fishermen from other fishing coves came here...they set up here and stole our resources in the Management Areas" (*Punta de Choros Fishermen’s Association Leader 2*) "There is conflict between National Fisheries Service and the fishermen because the Marine Reserve limits are not marked ... suddenly the fishing grounds are close to

		the boundary of the reserve, so they need to be marked" (*Punta de Choros Fishermen's Association Leader 2*)
Effectiveness of management of SECMMs	Positive perceptions of performance of Management Areas (6)	"...with the Management Areas system, we care for the resource and see that ... by caring for the resource, we receive long-term benefits, and this has been demonstrated here" (*Los Choros Fishermen's Association Leader 1*) "An artisanal fisherman used to be regarded as a predator because he fished out of control ... weight, length and size were not regulated, and now, we work with another system, and this provided results "(Punta de Choros Fishermen's Association Leader 2) "Management Areas have worked well" (*Leader 3 from southern La Higuera*)
Tourism and fishing	Compatibles and complementary activities (4)	''They are compatible because tourism is strong in summer, and we finish fishing in December, and then we have nothing to do…'' (*Punta de Choros Fishermen's Association Leader 2*)

2.6.2. Punta de Choros area: the system-to-be-governed

A description of the natural ecosystem was previously given (see description of the study area above). While fishing is the main source of employment for the inhabitants of Punta de Choros, in recent years, the area has experienced a tourism boom, and fishermen have ventured into tourism activities using their boats for marine bird and mammal watching, boat rides and landings on islands (Gaymer et al. 2008, Thompson et al. 2008). Using National Forestry Corporation statistics of entries into the National Reserve as an indicator of tourist visits to the Punta de Choros area, a steady increase in visitors is observed since its creation with 534 visitors in 1992 to 44557 visitors in 2012[7]. The services associated with tourism have also increased significantly in the last five years (see Annex 2.2). One of the most requested ecotourism activities in the area is boat tours around the islands. This circuit includes navigating through ICHD-Marine Reserve, Punta de Choros and Isla de Choros Management Area waters and disembarking on Damas Island (National Reserve) or on Gaviota Island (Fig. 2.2). Once visitors are on Damas Island, they can hike trails designed by the National Forestry Corporation and observe flora or swim at the beach. A total of 94% survey respondents report having sighted at least four species of animals on the tour. When visitors were asked their reason for travelling to Punta de Choros, the most common responses were to see the landscape, the possibility of seeing dolphins, the marine fauna and to disembark on Damas Island (Table 2.5). When we pooled similar responses into new categories, it can be observed that the possibility of observing marine wildlife was the most common answer (51%). After their tour, when visitors were asked which they considered to be the most attractive aspect of

[7] www.conaf.cl

Punta de Choros, 38% said the marine fauna, 22% the landscape of the area and 22% the islands (Table 2.5). When asked whether they believed that there are negative impacts on biodiversity in the area as a result of tourist activity and the conditions under which it currently operates, 64% of visitors stated that tourism is well-managed and that there would not be major impacts. Finally, the visitors were asked about their prior knowledge of the existence of two protected areas in the region; 50% said they did not know of the existence of protected areas, while 31% said they only knew about the National Reserve, and 19% knew about both.Currently, it is the fishermen of Punta de Choros who are conducting the tours of the islands, and they have invested in new boats or built new fishing boats to transport tourists. There is a shift in the organization of the fishermen to transport tourists together with an internal coordination system, and fishermen have found a niche to supplement their income (Table 2.4).

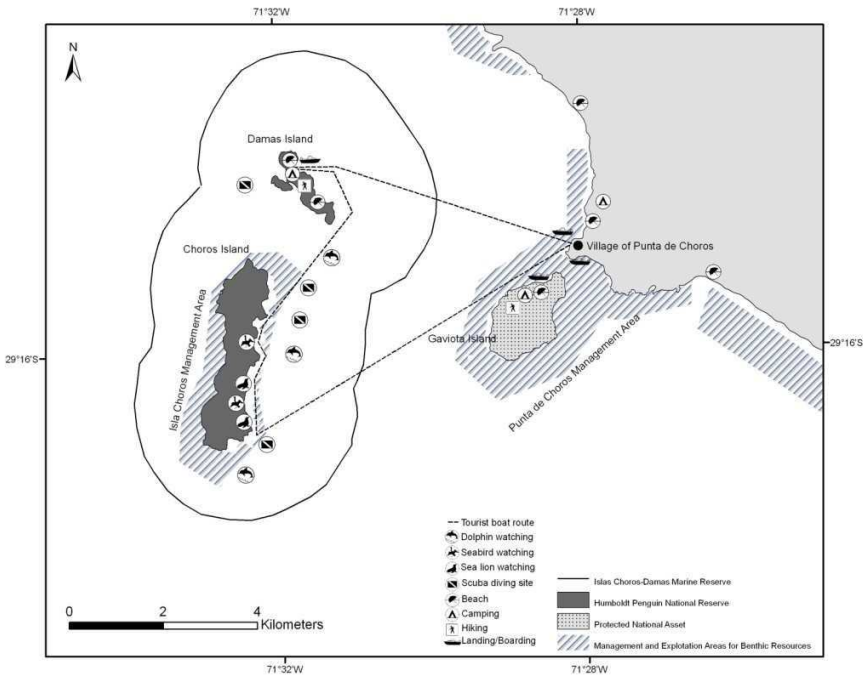

Fig. 2.2. Typical tourist route of traditional fishing boats in the area of Punta de Choros.

Table 2.5. Institutional interactions (described by means text and interviews analysis) that link the spatially explicit conservation and/or management measures in the Punta de Choros study area. Lines indicate the interaction range; dots indicate an indirect interaction through another institution. +: indicates a positive effect, -: a negative effect and Pot: a potential effect.

Institutional interactions	Description	ICHD-MR	MEARBs	HPNR	IG-NPA	Levels involved	Effects
Jurisdictional overlap	Real overlap or confusion about jurisdictional boundaries	●	●	●	●	Horizontal	-
Advisory councils	Stakeholders involved in more than one instance of consultation	●	●	●		Horizontal	Pot +
HPNR annual operating plan	Consideration of some type of institutional coordination	●	●	●		Horizontal	Pot +
Surveillance	Institutional surveillance over more than one area	●	●			Horizontal	Pot +
NSPWA	Possible incorporation of the ICHD-MR within the NSPWA	●		●		Vertical	Pot +
Multiple competencies	Government agencies responsible for more than one SECMMs	●	●			Vertical	+
Fisheries Law	Measures defined in the Fisheries Law	●	●			Vertical	Pot +
Fisheries Zonal Council	Measures considered in Fisheries Zonal Council Management	●	●			Vertical	Pot +
Communal development plan	Plan defines attractive areas for tourism development	●		●	●	Vertical	Pot + -
Coastal zoning	Regional Commission defines tourism-oriented and conservation areas	●	●	●	●	Vertical	Pot + -

ICHD-MR= Islas Choros-Damas Marine Reserve

MEARBs= Management and Exploitation Areas for Benthic Resources

HPNR= Humboldt Penguin National Reserve

IG-NPA= Gaviota Island National Protected Asset

SECMMs= Spatially Explicit Conservation and/or Management Measures

NSPWA= National System of Protected Wildlife Areas

2.6.3. ICHD-Marine Reserve in the wider social-ecological system

ICHD-Marine Reserve coexist in the Punta de Choros Area with other SECMMs established at different times and with diverse governance and institutional frameworks, as well as different goals and targets (Table 2.1 and 2.3). Three types of *connections* that occur or may occur among SECMMs could be identified or inferred from text and interviews analysis. The first type corresponded to *ecological processes* that are naturally connected to different SECMMs. The potential export of biomass from MPAs is one such process. A report of National Fisheries Service indicates that larvae and adults of the *C. concholepas* have been exported from the ICHD-Marine Reserve towards the Management Areas, ensuring the availability of individuals in early stages of development and therefore increased recruitment of populations of this species (Sernapesca 2011). Management Areas performance is assessed through annual monitoring reports in which the abundance of the main target species *C. concholepas* and annual catch quotas are used as indicators of effectiveness. Generally positive effects have been observed allowing uninterrupted annual catches since the implementation of these Management Areas. Sustained increases in abundance and catch quotas have been more evident for the resources at the Isla Choros Management Area adjacent to the ICHD-Marine Reserve (see Annex 2.3). Another type of ecological process corresponds to the movement of animals (e.g., penguins, sea lions) from their breeding or resting areas to feeding areas, which may be located both inside and outside the SECMMs.

A second type of connection corresponds to *socio-economic interactions* arising from implementing measures, such as the ICHD-Marine Reserve and National Reserve that restrict

the use and operation of, as well as access to, historical fishing areas and to temporary settlement sites for fishermen (Table 2.4).

Finally, a third type of connection corresponds to *threats* from activities within one SECMM that may affect the operation of another. We identified two threats: first, the tourist overload that occurs mainly in the summer months when more than 70% of the total annual visits to the National Reserve occur; and second, the lack of planning or management in the Gaviota Island National Protected Asset, which transforms it into an area under notably low protection with weak regulation of access and use.

Ten current *institutional interactions* influencing management and governance of ICHD-Marine Reserve were identified at different organizational levels (Table 2.6). These interactions occur as a result of the operation and administration of SECMMs themselves (i.e., horizontal interactions) but also through the actions of higher-level or central institutions (i.e., vertical interactions). Four of the interactions are horizontal, three of which have potentially positive effects on the management of the measures involved. For example, the fact that certain stakeholders (e.g., fishermen, tour operators, government agencies) belong to more than one consultation group (e.g., advisory boards) and the consideration of the existence of adjacent measures in the operational plans of the ICHD-Marine Reserve and National Reserve could generate instances of coordination and collaboration to regulate an activity or achieve a conservation goal and/or target. Jurisdictional overlap is an interaction with negative effects and is primarily due to a lack of clarity or confusion over jurisdiction and regulation, mainly in transition areas, such as beaches or aquatic areas at the boundaries between the ICHD-Marine Reserve and Management Areas (Table 2.6). Six of the interactions are vertical with potential positive effects. One is the possible incorporation of the ICHD-Marine Reserve within the

National System of Protected Wildlife Areas, which already includes the National Reserve and would be administered by a new service under the Ministry of Environment (i.e., Biodiversity and Protected Areas Service). Other interactions indirectly linking the ICHD-Marine Reserve and the Management Areas are that both are defined by the Fisheries Law, which is a law that is periodically modified and improved. Additionally, both are measures considered in the management of the Fisheries Zonal Council, a public-private consultative body that makes decisions regarding development issues and fisheries research. The National Fisheries Service, which is the current administrator of the ICHD-Marine Reserve, must also play a funding role both in the ICHD-Marine Reserve and the Management Areas. Finally, potential negative or positive interactions (i.e., depending on the type of tourism to be developed) correspond to the definition of areas as high tourist attraction areas in the communal development plan. Similarly, coastal zoning and preferential allocation of uses in this area are conducted by the Coastal Border Regional Commission (Table 2.6).

Table 2.6. Visitors survey results in the Punta de Choros study area. Numbers indicates proportion (%) of reasons for visiting and recognition of natural attractions.

Reason for visiting		Recognition of major natural attractions	
Seascape	26	Marine fauna	38
Dolphins	25	Seascape	22
Marine fauna	13	Islands	22
Damas Island	13	Beaches	7
Penguins	7	All	7
Whales	5	Flora	2
Protected area	5	Quiet place	2
Others	6		
Total marine fauna*	50		

*Sum of Dolphins, Marine fauna, Penguins and Whales

2.7. Discussion

2.7.1. Implementation of ICHD-Marine Reserve at the Punta de Choros area

The declaration of ICHD-Marine Reserve and other SECMMs in the study area is based on different paradigms and national and international conservation legal frameworks (e.g., terrestrial reserve v/s marine reserve). With the exception of the Management Areas, the processes for declaring protected areas in the study area were carried out centrally with little or no stakeholder consultation or participation. A similar situation was reported for other MPAs in the country (Fernández & Castilla 2005, Vega 2011). The implementation of the ICHD-Marine Reserve, the National Reserve and the Isla Choros Management Area displaced most of the fishermen at the Municipality of La Higuera from their historical fishing grounds. Under this scenario, only one fishermen organization (Punta de Choros Fishermen's Association) does not see these measures as a restrictive imposition of the central government but instead fully participated in their implementation. The Management Areas of this organization, due to their proximity to the ICHD-Marine Reserve, could potentially obtain greater benefits. Furthermore, fishermen in this organization are those who are mainly involved in ecotourism activities in the area. Generally, the implementation of MPAs reduces and restricts the level of activity in a given area altering the relationships among user-groups and adding sometimes conflicts or generating new ones (Jentoft et al. 2007, Mascia et al. 2010). Pollnac and Pomeroy (2005) indicated that the acceptance of and subsequent community involvement in implementing an MPA can be influenced by the perception of early benefits. We identified a sense of possession or ownership on the ICHD-Marine Reserve by the Punta de Choros Fishermen's Association, and this feeling is obviously enhanced by

the location of its Management Area (next to the ICHD-Marine Reserve and National Reserve) and evident in the active participation of this association in the surveillance of the ICHD-Marine Reserve. Rodríguez-Martínez (2008) noted that for an MPA in Puerto Morelos, Mexico, due to the small size of the associated community and their strong sense of ownership, there were high levels of participation in the decision-making process. According to Jentoft et al. (2007), it makes a big difference to improve MPA governability if users and stakeholders are able to identify the MPA as *theirs* rather than of *someone else*. Achieving this sense of ownership would be more complicated when community members feel that an MPA was imposed from outside (e.g., fishermen from south of the municipality). There is evidence that the acceptance, involvement and early participation of the affected community in planning and decision-making activities are keys for effective implementation of marine conservation measures (Pollnac et al. 2001, Rodríguez-Martínez 2008). In our study, the affected community does not necessarily correspond to the inhabitants of the Punta de Choros village, but rather to the entire fishing community in the Municipality of La Higuera. Additionally, this community does not necessarily correspond to a homogeneous community, as there are differences in the ways problems and opportunities are perceived regarding the use of resources and their management. For example, the interest in the ICHD-Marine Reserve from fishermen´s organizations from the southern part of the municipality is mainly focused on access to surpluses of commercially important species within the marine reserve (Gaymer et al. 2007). It is also critical to consider the perceptions of different stakeholders regarding the implementation of ICHD-Marine Reserve in the area of Punta de Choros. Understanding cultural factors as individual beliefs and values regarding human-nature interactions are keys to understanding stakeholders' attitudes towards management measures, gaining their

acceptance and compliance with rules, and reducing conflicts (Fischer & Young 2007). This understanding becomes more important when MPAs are enacted and enforced without clear procedures and without considering the socio-economic factors affecting communities, or when responding to international obligations and commitments.

Ecotourism is a cross-cutting issue at the Punta de Choros area and is recognized as a great opportunity for the development of the local economy. Ecotourism is acknowledged for playing a central role in biodiversity conservation and improvement of local community incomes (principally in developing countries), without mainly compromising ecosystem conservation (Gössling 1999, Tisdell & Wilson 2001). Ecotourism activities such as wildlife watching has been increasingly associated or centered on protected areas (Balmford et al. 2009). The existence of several flagship species at the Punta de Choros area has undoubtedly promoted the development of ecotourism. Worldwide, the economic opportunities offered by tourism linked to MPAs have resulted in groups of fishermen being engaged exclusively or partly in this activity (Dobson 2008). It has been suggested that the development of tourism is perceived by some fishermen as risky in respect to the stability of the social and cultural structures of the fishermen communities near MPAs (Oracion et al. 2005). However, the interviewed fishermen did not see major problems in conducting both activities. When tourism is largely unregulated and intensive, changes in marine communities and ecosystems and adverse effects on surrounding human communities have been recognized (Davenport & Davenport 2006). According to Butler (1974), the magnitude of social impacts associated with tourism increases with the number of visitors. The fishermen of Punta de Choros recognize that are exploiting the ecotourism potential of the area, but they also recognize the impacts

associated with seasonal and permanent population increases, such as increased garbage, loss of landscapes and loss of tranquility in the village (P.F. Cárcamo unpublished data).

2.7.2. ICHD-Marine Reserve in the wider social-ecological system

From a governability viewpoint, the relationships and interactions between MPAs and their ecological and socio-cultural environments require the same attention as those pertaining to the internal structures and interactions of MPAs (Jentoft et al. 2007). ICHD-Marine Reserve is highly connected with other SECMMs through various ecological processes. The potential export of biomass from ICHD-Marine Reserve towards the Management Areas (and probably vice versa) is one of such processes. Gelcich et al. (2008) proposed that the hundreds of existing Management Areas in Chile could act as a network of ancillary sites that complement the conservation goals and targets of MPAs. However, measurements of the effectiveness of the ICHD-Marine Reserve (e.g., the potential biomass export as spillover and/or propagules export; Gell and Roberts 2003) and communication of these data are needed to reveal its real contribution to fisheries management and its influence area. Jentoft et al. (2007) stresses that from a governability perspective, outreach and education on how to preserve these ecological interactions is crucial.

The movement of animals between breeding or resting areas and feeding areas is another process that connects the SECMMs and implies strong interactions with activities such as fishing[8] and ecotourism. An increase in the frequency of boats around the islands and tourists landing on Damas Island (i.e., observed trend) will result in an increased probability of

[8]Recently, the regional press reported the illegal slaughter of sea lions and seabirds in the area of Punta de Choros probably associated with dynamite fishing.

disturbance of wildlife. Indeed, there is already evidence of negative effects of tourism on some species of marine mammals (Pavez et al. 2011) and penguins (Ellenberg et al. 2006). Regulations for tourism were recently generated within the management plans for ICHD-Marine Reserve and the National Reserve (Conaf 2009, Sernapesca 2010) and are being implemented. Further, a general regulation for bird, cetacean and reptile watching was approved in 2011 which will help to regulate tourism activities in Chile and specifically at the Punta de Choros area (Subpesca 2012). However, institutional enforcement capacity is still limited. On the other hand, the lack of planning at the Gaviota Island National Protected Asset is of concern, especially if we consider that the island's current state of high human intervention and environmental degradation is the probable cause of the absence of nesting birds and reproducing native mammals (Luna-Jorquera et al. 2012).

Current institutional interactions to generate positive effects on management are still scarce and efforts should be made to implement potential ones. Although the administration of SECMMs at Punta de Choros is provided mainly by government agencies, there are many institutions that, despite participating primarily in a consultative role, are shaping institutional social networks (e.g., NGOs, universities; P.F. Cárcamo unpublished data). The management of any resource benefits from players agreements, e.g., common rules and practices, coordinated use of resources, information sharing, participation in conflict resolution, building a common understanding and negotiating various trade-offs (Ostrom 1990, Armitage et al. 2008). Recent research has shown that networks and their structural properties affect collaborative processes and therefore should be considered fundamental variables in the search for explanations of success or failure when managing natural resources (Marín & Berkes 2010, Sandström & Rova 2010, Grilo 2011). The development of social networks and the creation of

partnerships among institutions in the area of Punta de Choros could improve tourism sustainability and governance of the entire area. Improving horizontal and vertical institutional interactions among marine reserves and Management Areas, for example, will be crucial for incorporating future considerations related to biodiversity conservation into decision making at higher organizational levels (e.g., Undersecretary of Fisheries, Fisheries Zonal Council).

2.7.3. Governance challenges for the ICHD-Marine Reserve

Given the small spatial and jurisdictional scales of the ICHD-Marine Reserve, its effectiveness cannot be assured. At this respect, Jentoft et al. (2007) stressed the need to consider MPAs as systems embedded in the larger social-ecological system. On the other hand, the singularity of the Punta de Choros Area (e.g., biodiversity hotspot, productive fisheries, SECMMs) require that the ICHD-Marine Reserve governing system to be incorporated into a broader spatial scale governance system, which becomes imperative, for example, for the protection of highly mobile species and their migratory or feeding routes (e.g., seabirds and marine mammals) and for defining the type of ecotourism development that is desired for the area. Recognizing that wildlife watching is one of the main attractions of ICHD-Marine Reserve and the Punta de Choros area and continues to expand, it is likely that conflicts between marine wildlife and recreational and touristic uses will increase in future years. For minimizing the disturbance and negative impacts on marine wildlife it is therefore urgent to apply existing regulatory mechanisms (e.g., regulation of marine wildlife watching), and also to develop management strategies to evaluate and incorporate ecological processes inherent to the flagship species of the area (e.g., daily movements, migratory routes) and its implications in spatial terms respect

to the use of the area and the overlap with ecotourism activities. In addition, and considering that ecotourism is a driver of growth with socio-economic importance to human communities in the Punta de Choros area, and it further affects all the SECMMs, it is urgent to make progress not only in understanding the effects on particular species and biological communities but also on the social-ecological system (Strickland-Munro et al. 2010). Other important issues are current or potential human uses in the coast near the Punta de Choros area, such as industrial fishing, mining ports, and power plants that are perceived as high-level threats for biodiversity conservation and ecosystem services provision (P.F.Cárcamo unpublished data). Recently, several coal-fired power plants projects were abandoned in the midst of social conflicts and controversies regarding their location and compatibility with existing uses and conservation goals (Cárcamo et al. 2011).

Beyond compliance with existing sectoral regulations (e.g., fishing, tourism), the design and implementation of any strategy to ensure benefits, both for biodiversity and local people, and to minimize unintended consequences (e.g., disturbance on wildlife) will require the involvement of local people and governing systems of SECCMs. This study showed several potential institutional interactions between SECCMs and the community that could be mobilized to generate an inclusive governance system with SECCMs, government agencies, and stakeholders in the area. As it has been noted by Jentoft et al. (2007), the solutions for improving the governability and effectiveness of MPAs are likely found both in the governing system as in the system-to-be-governed, and also in the way that MPAs interact with their ecological and social environment.

Efforts should be made by national and regional governments to develop policies and implement strategies to change the focus from fragmented multilevel governance regimes, as

observed in the current operation of the SECMMs at the Punta de Choros area, towards new adaptive governance systems that lead to spatially larger-scale ecosystem-based management (e.g., Great Barrier Reef, Olsson et al. 2008). A proposal for declaring a big area (including Punta de Choros area) as a Multiple-Use Coastal Marine Protected Area (Oceana 2010) emerge as an interesting pathway to develop new systems of governance and management. This type of MPA has been recognized as a tool for managing large and diverse marine ecosystems (Mangi & Austen 2008) and an opportunity to implement ecosystem-based management in Chile (Cárcamo et al. 2013).

2.8. Conclusion

Human-dominated seascapes where uses such as fishing, aquaculture, tourism and SECMMs coexist, become a commonplace both in Chile and around the world, hindering the establishment of new coastal MPAs (e.g., Fraschetti et al. 2009) and affecting the performance of existing ones, resulting in great challenges for their management and governance. The recognition and understanding of the interactions among human, institutional, and ecological dimensions beyond those existing within the MPA will be a crucial step to improve its performance. As noted by Folke et al. (2007), the problem regarding the low fit between ecosystems and governance institutions is due to the interaction between the human and ecosystem dimensions of social-ecological systems that are not only related but are truly integrated.

This study illustrated a small MPA highly connected to a wider social-ecological system through various ecological processes and socio-economic interactions. The social and

ecological embeddedness of any MPA (Jentoft et al. 2007) implies that management actions must recognize interferences or disturbances from outside conditions and consider some of these actions (e.g., ecotourism management, zoning) as cross-cutting actions for the entire social-ecological system. The same concerns must be addressed for the inclusion of MPAs within a wider governance framework (e.g., Multiple-Use MPA, ecosystem-based management). Current and potential institutional interactions (as described for ICHD-Marine Reserve) together with the development of social networks are opportunities to any cooperative and collective effort aiming to improve management and governance of MPAs (Bodin & Prell 2011).

The top-down establishment of MPAs in Chile, without considering the system-to-be-governed and the negative or unbalanced consequences of their implementation on direct users (e.g., fishermen displacement, unequal opportunities for developing tourism), requires government agencies in charge of MPAs administration to increase stakeholders involvement in MPAs development. We propose communication of connections and interactions between MPAs and other SECMMs and uses (as described in this study) as a strategy to involve stakeholders and improve their participation in MPA management and governance.

Capítulo 3. Opportunities and constraints of the institutional framework for the implementation of ecosystem-based management: The case of the Chilean coast[9]

[9] Cárcamo, P.F., Garay-Flühmann, R., Gaymer, C.F. 2013. Opportunities and constraints of the institutional framework for the implementation of an ecosystem-based management: The case of the Chilean coast. Ocean & Coastal Management 84: 193-203.

3.1. Abstract

The implementation of ecosystem-based management usually develops from existing institutional and governance arrangements in a given area. Therefore, it is necessary to analyze the institutional framework of a region or country to assess whether this framework is compatible and whether it will promote or potentially hinder the implementation of new management strategies. This paper explores the possibilities and constraints of institutional frameworks (represented by legislation) concerning the possible implementation of ecosystem-based management of the Chilean coast.We evaluated the functional fit between a conceptual ecosystem defined by stakeholders (and based on ecosystem services, threats and uses/activities) and Chilean legislation related to coastal and marine resource planning and management. First, we measured the functional fit between the defined ecosystem and legislation through a quantitative analysis based on text revision and network analysis. Second, we evaluated different management, conservation and planning instruments existing in Chilean legislation, with respect to their suitability for the implementation of ecosystem-based management. We found that Chilean legislation rarely accounts for relationships defined between the different components of the ecosystem model. We observed low functional fit potential and many gaps in legislation. However, we found that certain existing instruments in the current legislation can be used as a foundation for implementing management based on the principles and criteria of ecosystem-based management (e.g., Multiple-Use Coastal Marine Protected Areas).

3.2. Introduction

Ecosystem-based management (EBM) is currently promoted as an alternative to traditional approaches with respect to the management of natural resources based on single objectives, activities or species (McLeod & Leslie 2009, Lubchenco & Sutley 2010). A general definition for EBM corresponds to a place-based approach that considers the entire ecosystem and the connections between its various components. These connections include a strong link between social and natural systems that focuses on the maintenance of a healthy, productive and resilient ecosystem that is able to provide the services required by humankind (Christensen et al. 1996, McLeod & Leslie 2009, Kidd et al. 2011). There is no single or correct way to implement EBM because it can be implemented in different places and across a range of spatial scales, each with a particular historical, institutional, social and ecological context (McLeod & Leslie 2009). Given the high interdependence of natural and human resources, the identification and understanding of various stakeholders, including their perceptions, practices, interests and expectations, are essential for EBM implementation (Gelcich et al. 2005, Pomeroy & Douvere 2008). One of the challenges of EBM is to define a common vision that includes social and environmental aims and ecosystem services that people are interested in maintaining or restoring (Leslie & McLeod 2007, McLeod & Leslie 2009).

The adoption of new management strategies often involves changing paradigms and new institutional and governance challenges (Ruckelshaus et al. 2008, Carollo & Reed 2010). The transition towards EBM is not groundbreaking; implementation develops from already existing institutional and governance arrangements in a given area (Olsson et al. 2008,

Ekstrom & Young 2009). One concern is the extent to which the institutional framework[10] of a region or country (e.g., laws, governance structure and institutional arrangements) supports, promotes or hinders the implementation of new management strategies. Therefore, analyzing the institutional context becomes as important as studying the physical and biological environment of the ecosystem that will be effected. From a social-ecological system perspective, environmental governance can be studied through the exploration of the spatial, temporal or functional fit between institutions and natural ecosystem components (Folke et al. 2007). For example, gaps in governance or legislation related to links within and between uses, or benefits received by human and ecosystem properties, can be understood as functional misfits (Ekstrom & Young 2009, Holt et al. 2011). From an institutional perspective, EBM can be viewed as an attempt to develop an institutional ecosystem that builds, manages and maintains inter-organizational networks. EBM goals for improving resource management include changing institutional arrangements and improving the coordination among organizations that form networks (Imperial 1999).

The study of governance structures, i.e., organizational solutions for the creation of effective institutions, is an important component of institutional analysis (Hagedorn 2008). Institutional analysis, i.e., the process of analyzing the design and operation of an institutional arrangement, should be of paramount importance in *ex-ante* planning of management strategy implementation. In the planning stage, patterns, networks and resource flows can be identified and the adequacy of the institutional framework for the implementation of the strategy can be assessed.

[10] We adopt the definition of Ostrom (2005): institutions are prescriptions that humans use to organize all forms of repetitive and structured interaction. This broad definition would include the legal system as an institution.

With respect to marine resources, Chile joins the international contingency, both in management crisis and the adoption of new management strategies (Thompson et al. 2008, Gelcich et al. 2009a, Leal et al. 2010). Additionally, Chile has signed international agreements on biodiversity conservation that promote ecosystem approaches as a management alternative (Sierralta et al. 2011, Squeo et al. 2012). The aim of the present study is to explore the potential institutional fit of a hypothetical scenario of implementation of EBM in Chile. Accordingly, we analyzed the fit and gaps between the legal framework related to resource management and a highly productive and diverse coastal marine ecosystem in northern Chile, where different uses and current and potential conflicts exist (Cárcamo et al. 2011). Subsequently, we evaluated different management, conservation and planning instruments associated with marine and coastal resources that exist in the Chilean legislation, with respect to their suitability for the implementation of EBM. This study will discuss the short-term feasibility of implementing EBM on the Chilean coast.

3.3. Methods

3.3.1. Research Area

The research area corresponds to a coastal islands system in northern Chile (28° 54'S - 29° 45' S; Fig. 3.1) that belongs to the transition region of the Temperate Humboldt Current System (Thiel et al. 2007). The fishing and ecological characteristics of this system have made it an area of great interest for both fisheries and conservation (Luna-Jorquera et al. 2012). Several marine and terrestrial biodiversity conservation and management and exploitation areas for benthic resources (MEABRs) have been established (Cárcamo et al. 2011).

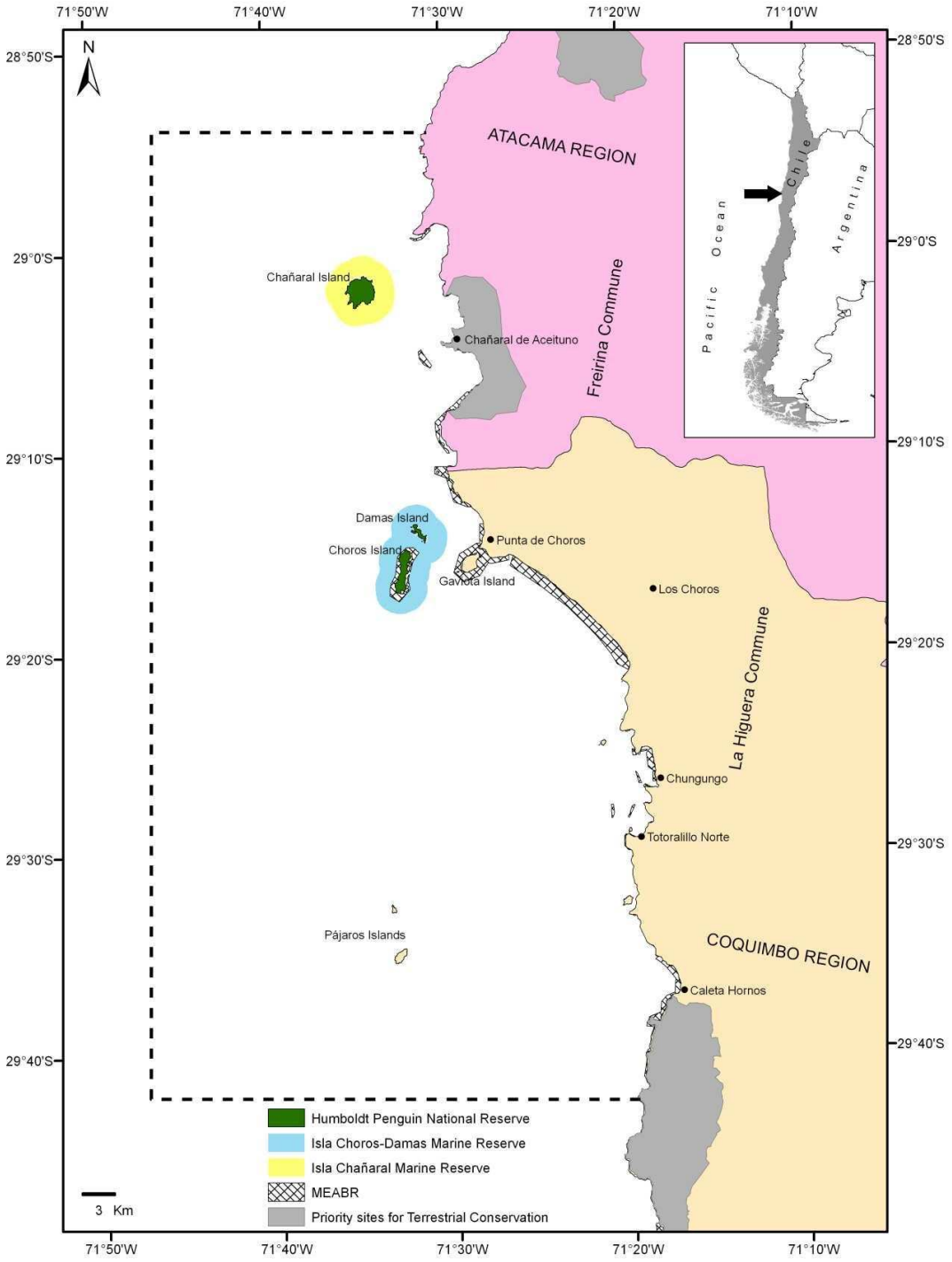

Fig. 3.1. Research area indicating the existing conservation and management areas. The dotted line indicates the area proposed as MU-CMPA.

With respect to the political-administrative division of Chile, the study area includes the coastal areas of the communes of Freirina (Huasco Province, Atacama Region) and La Higuera (Elqui Province, Coquimbo Region). Fishing is the main source of employment for residents of the small coastal villages; however, due to tourism growth in recent years, fishermen have diversified their income opportunities to include wildlife watching activities (Gaymer et al. 2008). Possible installation of coal-fired power plants near these protected areas generated social conflict and controversy (Cárcamo et al. 2011). Potential conflicts are currently foreseen with the building of mining ports, which is planned for the same coast. In 2009, this area was determined to be a priority site for conservation by the National Fisheries Service (SERNAPESCA) and the National Forestry Corporation (CONAF), and in 2010, an NGO proposed that the Chilean Government evaluate the possibility of declaring this area a Multiple-Use Coastal Marine Protected Area (MU-CMPA).

3.3.2. Ecosystem delimitation and institutional framework

Under the premise that EBM considers humankind to be part of an ecosystem, we present the study area as a conceptual ecosystem model based on environmental components identified by stakeholders. The study population corresponds to all individuals, groups or organizations that are involved, interested or affected by use initiatives, management and/or conservation of natural resources that occur in the coastal marine area of the communes of La Higuera and Freirina. We established the stakeholder sample as follows: first, based on different sources[11],

[11] Review of minutes of participatory committee meetings related to management and conservation initiatives in the area (e.g., marine reserves), interviews with four stakeholders (researchers, neighborhood leaders, fishermen leaders, government agency representatives), and a review of the composition of advisory boards and operating committees of national protected areas,

we triangulated information and defined an initial group of twenty key informants who represented diverse organizations; second, we asked the informants to suggest other stakeholders who they considered to be relevant to the survey from a management context, and these stakeholders in turn could suggest others stakeholders. This approach is a non-probabilistic sampling technique called snowball sampling (Ritchie et al. 2003). Third, as a criterion for the inclusion of stakeholders in the sample, we used only those stakeholders who were mentioned by two or more of their counterparts. Finally, we conducted a face-to-face survey with 42 stakeholders during the period November 2011 to December 2012, to identify and evaluate three ecosystem-related components that benefit humankind: 1) services provided by ecosystems, 2) threats to the provision of these services and 3) current and potential uses/activities in the area.

To define the institutional framework, we generated a collection of legal documents directly or indirectly associated with the identified environmental components. These documents included laws, decrees, regulations, policies, multilateral agreements, regional development strategies and planning instruments. The documents originated mainly from the following domains: biodiversity conservation, management and exploitation of natural resources, fisheries, aquaculture, environmental protection and regulation, water pollution, marine and coastal jurisdiction, navigation, urban development, citizen participation, tourism, scientific research, regional economic development and marine and coastal management and planning. These documents were obtained from the website of the National Library of Chilean Congress[12] or were requested directly from government agencies. All of the documents were

[12] www.bcn.cl

categorized according to the geopolitical jurisdiction of its application (international, national, regional, municipal), scope and agencies involved in its implementation.

3.3.3. Gap analysis and institutional fit

To identify legal gaps and the fit between institutions (i.e., legislation) and the studied ecosystem, we used a quantitative analytical technique developed by Ekstrom and Young (2009) and Ekstrom *et al*. (2009). According to Ekstrom and Young (2009), institutional gaps correspond to links in a target ecosystem that are not accounted for by existing legislation. The fit potential corresponds to the existing links in a target ecosystem that are accounted for by the existing legislation. The more links that are accounted for by legislation, the higher the potential for institution-ecosystem fit. The technique is based on text and network analysis and has been implemented in the software MINOE 1.10 (Ekstrom et al. 2010). For the analysis, MINOE requires a model of the relevant ecosystem and a document collection. The ecosystem model was built from environmental components identified in 3.3.2. The ecosystem model was represented by a symmetric matrix and the existence of relationships between two components was represented through binary code (i.e., dyads). The document collection was associated with a metadata file indicating particulars such as the file name, the title and description of the document, and agencies responsible for implementation. MINOE conducted a text analysis of the document collection to determine which component dyads of the ecosystem model were potentially recognized in legislation. Each component was defined by one or more terms or phrases (see Annex 3.1). Components that co-occurred in the legislation were potential links, while components that did not were potential gaps.

To assess the degree of fit between the model ecosystem and the document collection, we used the *M* metric or institutional-ecosystem fit (Ekstrom & Young 2009):

$$M = p11 / (p11 + p10)$$

where $p11$ is the total number of cells that, in the ecosystem model and in the co-occurrence legislation matrix, have a > 0 value, and $p10$ is the total number of cells that, in the ecosystem model, have a 1 value and in the co-occurrence legislation matrix, have a 0 value. *M* indicates the degree of similarity between the document co-occurrence matrix and the ecosystem model, and it can be used as an indicator of fit potential between institutions and the ecosystem. A high score indicates that a high number of links between the ecosystem components are accounted for by the legal framework. We also calculated *M* for each individual component and mean values for each of the three types of environmental components. From the identified links, we classified documents and agencies according to their involvement level, and dyads of components according to the number of documents and agencies involved.

Differences in *M* index, links, gaps, documents and by-link agencies between environmental component types were tested with a non-parametric Kruskal–Wallis test using rank sums instead of means (Zar 1996). Statistical analyses were performed with R environment version 2.15.2 (R Core Development Team 2012). Network graphs were built with NETDRAW 2.1 (Borgatti 2002).

3.3.4. EBM in Chilean legislation

Based on reviews related to planning and management of marine and/or coastal natural resources defined in Chilean legislation (Andrade et al. 2008, Sierralta et al. 2011), we evaluated different instruments available in Chilean legislation. We reviewed goals, targets, planning and implementation experiences for each instrument and contrasted them with the main principles and criteria that characterize EBM. A selection of elements and categories that are considered to be characteristic of EBM was obtained from relevant literature related to marine and coastal management (Christensen et al. 1996, Shepperd 2004, Arkema et al. 2006, McLeod & Leslie 2009, Kidd et al. 2011). For each instrument, we assigned a qualitative value (low, medium, high) to the presence of each element of EBM: low, when the EBM element was unclear and not explicit; medium, when the element was explicit; and high, when the element was explicit and there was evidence of its implementation.

3.4. Results

3.4.1. Ecosystem model and institutional framework

The respondent stakeholders represented different agencies and organizations that had a direct link with the area (Table 3.1). The most represented agencies were the Artisanal Fishermen Organizations and National Government Agencies.

We built a potential ecosystem model for the application of EBM, incorporating environmental components identified and valued by stakeholders and representing various interests in the area. A total of 45 environmental components were identified: 15 ecosystem

goods and services, 14 threats to their provision and 16 current or potential activities and/or uses. We used environmental components that were valued as the most important components in the area (Fig. 3.2).

One hundred and eighty four legal documents were reviewed and incorporated into the collection. Fisheries and aquaculture, environmental international agreements, institutional statutes, and protected areas and environment were the subjects with a substantial amount of documents (see Annex 3.2 and 3.3). One hundred formal organizations were referred to and were involved in the documents, including central government and regional agencies, local government, civil society organizations and business associations (see Annex 3.4).

Table 3.1. List of respondent stakeholders categorized by type of organization (N=42).

Type of Organization	Number	Description
Civil Society Organization	1	Neighborhood Association
Diving Organization	1	Underwater Sports Association
Artisanal Fishermen Organization	10	4 Trade Associations, 3 Unions, 2 Cooperatives, 1 Federation
Land Owners	2	Agricultural Communities
Local Government	2	Municipalities
National Government Agencies	12	2 National Fisheries Service (Coquimbo and Atacama Regional Offices), 2 National Forestry Corporation (Coquimbo and Atacama Regional Offices), 2 Regional Undersecretary of Ministry of Environment (Coquimbo and Atacama Regional Offices), 2 National Tourism Service (Coquimbo and Atacama Regional Offices), 2 Direction of Maritime Territory and Merchant Navy (Coquimbo and Atacama Regional Offices), 1 Agriculture and Livestock Service (Coquimbo Regional Office), 1 Ministry of Housing and Urbanism (Coquimbo Regional office)
Environmental NGO	2	1 Local NGO, 1 International NGO
Public-Private Committee	1	Advisory Council Protected Area
Regional Government Agencies	3	1 Coquimbo Regional Government, 1 Atacama Regional Government, 1 Fisheries Zonal Council
University or Research Institute	4	2 Regional Universities, 1 Regional Research Center, 1 National Fisheries Research Institute
Technical Consultant	1	1 Technical Consultant associated fisheries management
Tourism Enterprise	3	2 Tourism Associations, 1 Diving Center

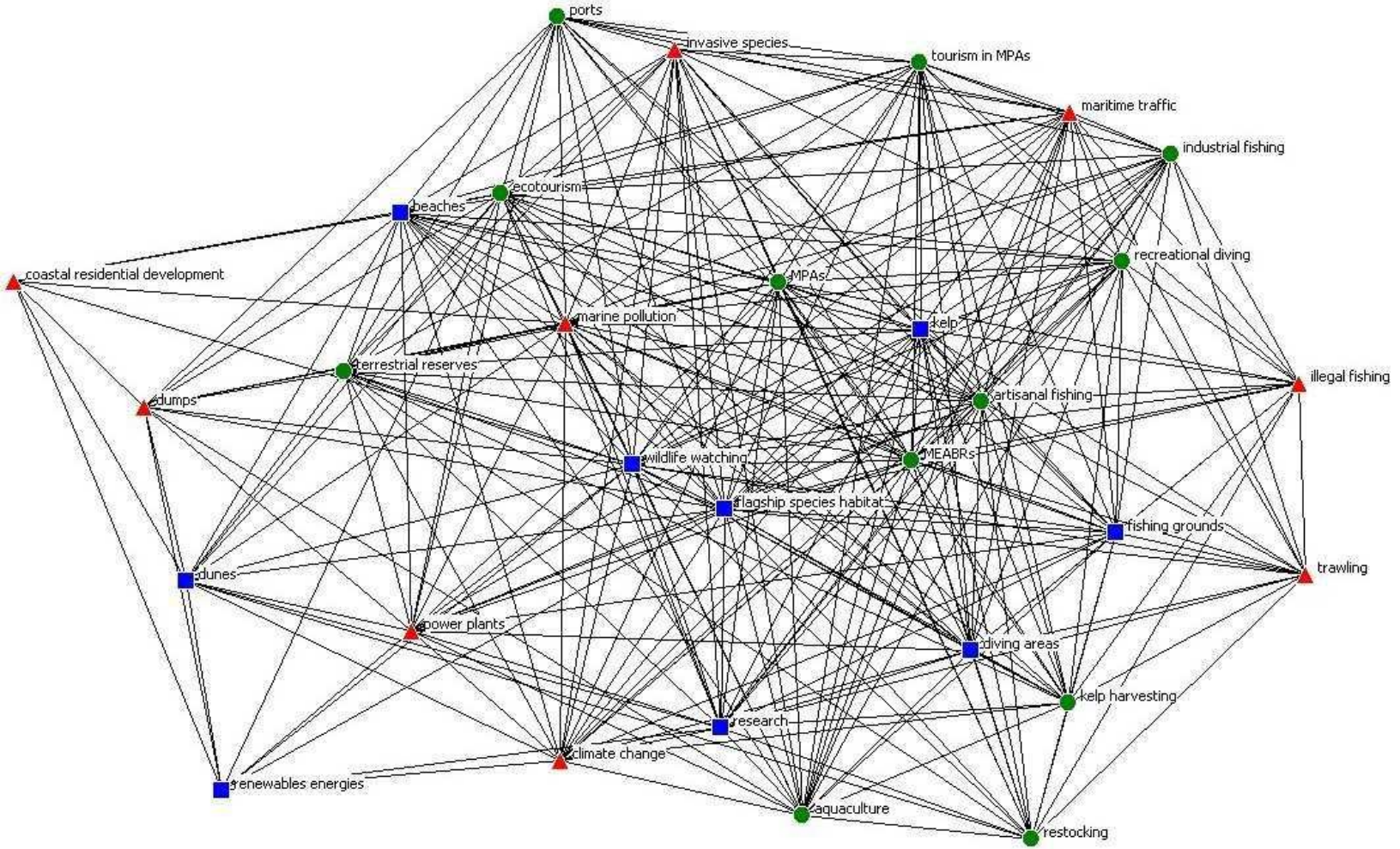

Fig. 3.2. Ecosystem model network built from the identification and valuation of environmental components by stakeholders. Blue squares represent ecosystem services, red triangles threats and green circles current and potential uses. Lines represent relationships between two components. Network built with NETDRAW. MEABRs= management and exploitation areas for benthic resources.

3.4.2. Gap analysis and institutional fit

The terms representing ecosystem components that appeared most often in the document collection were aquaculture, marine pollution, ports, research and beaches (Fig. 3.3). From a total of 294 possible dyads that linked components, legislation accounted for this link in only 49 cases (Fig. 3.3, also see Annex 3.5). Dyads with more documents that accounted for the relationship were MEABRs-aquaculture, artisanal fishing-aquaculture, artisanal fishing-MEABRs with 14, 13 and 8 documents, respectively (see Annex 3.6). Contrastingly, 7 components were not linked to another component; 2 ecosystem services (diving areas and renewable energies), 3 threats (illegal fishing, trawling and coastal residential development) and 2 uses/activities (industrial fishing and recreational diving) (Fig. 3.3). When we analyzed the number of links between single ecosystem components, we found that, with respect to the ecosystem services group, research, beaches and wildlife watching had the strongest linkage. These components in turn had the highest number of documents and agencies involved. With respect to threats, marine pollution had the strongest linkage, and together with climate change they were the groups with the greatest number of documents and agencies involved. With respect to uses/activities, artisanal fishing and aquaculture had the strongest linkages. The latter activities, together with MEABRs, were those with the highest number of documents and agencies involved (Figs. 3.4 and 3.5). Documents that had the strongest presence in the different linkages were the Law on Fisheries and Aquaculture, the Communal Tourism Plan and the decrees of Coastal Zoning. The agencies with the strongest presence in the different links were DIRECTEMAR (Direction of Maritime Territory and Merchant Navy), the

Environmental Ministry, SUBPESCA (Undersecretary of Fisheries) and SERNAPESCA (National Fisheries Service) (see Annex 3.6).

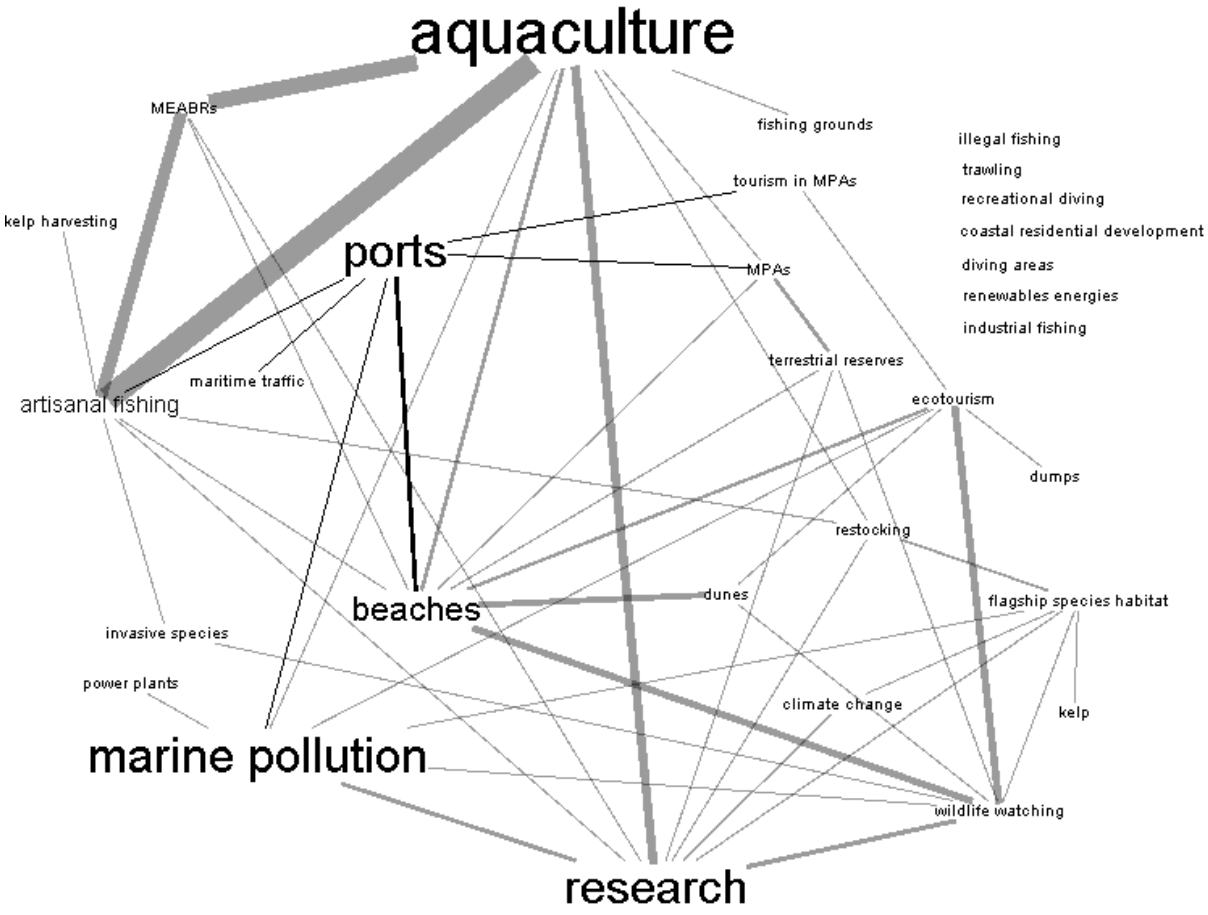

Fig. 3.3. Network representing the links that legislation accounted for by the ecosystem model. Lines indicate those modeled links for which ecosystem components co-occur closely together in one or more documents. Thickness of lines varies with the frequency of components' co-occurrence. Terms size is directly proportional to the occurrence frequency in the document collection. Network built with MINOE. MEABRs= management and exploitation areas for benthic resources.

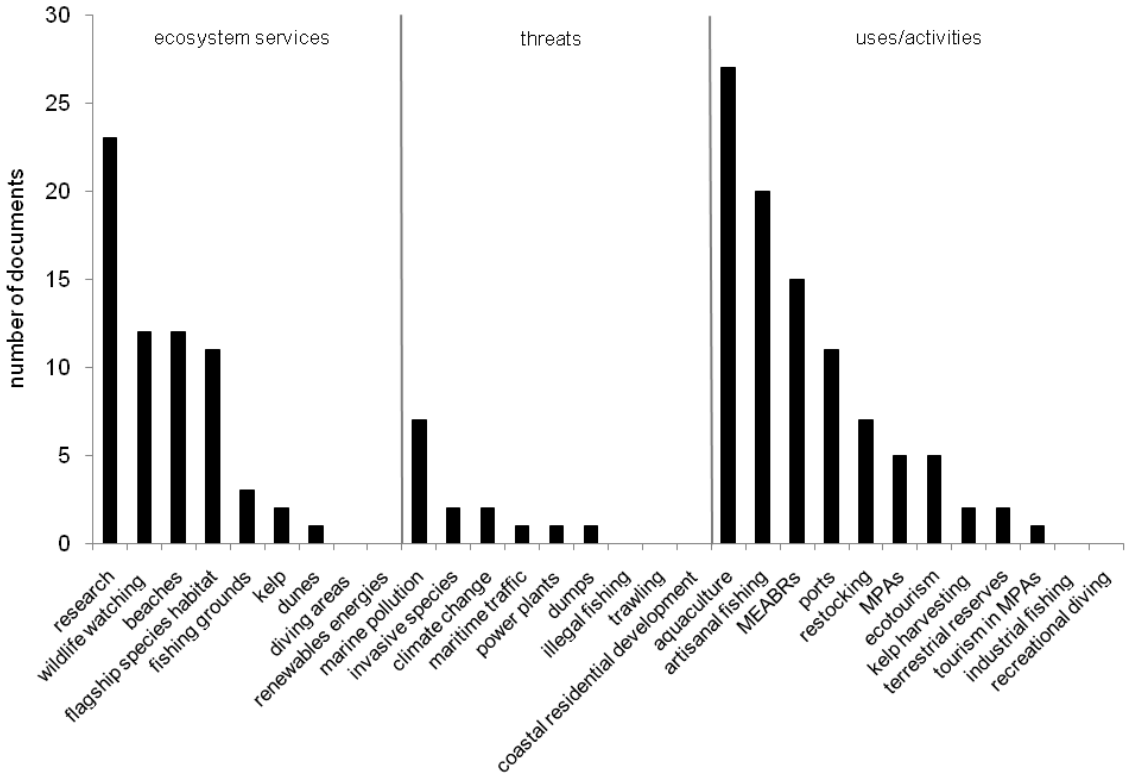

Fig. 3.4. Collection documents per ecosystem component, involved in links that are accounted for by legislation.

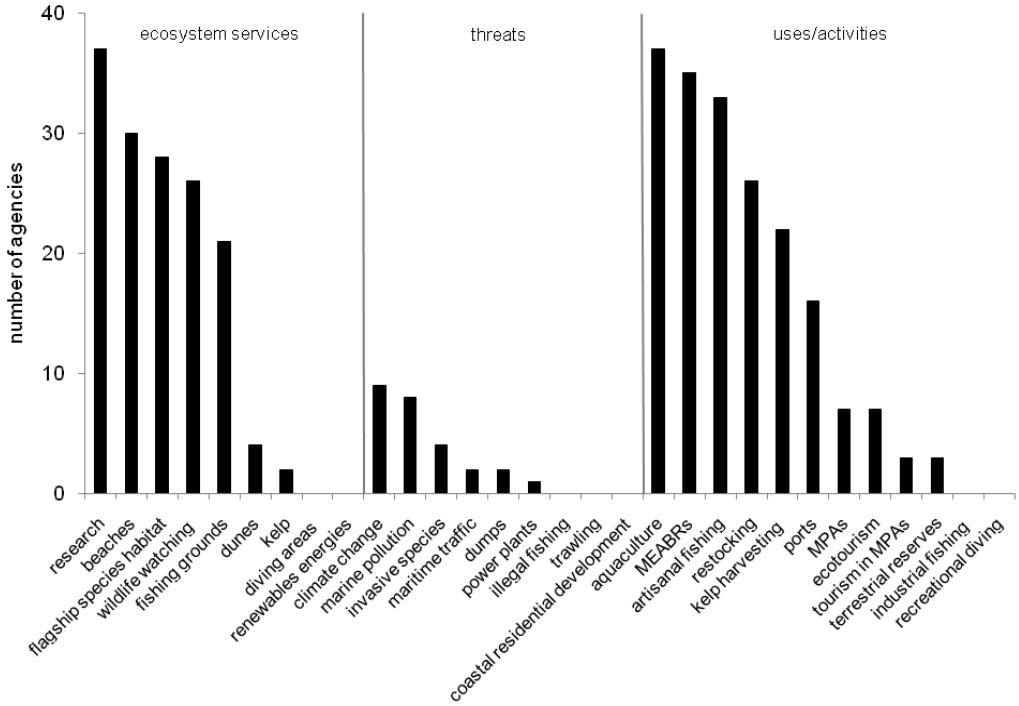

Fig. 3.5. Agencies and organizations, per ecosystem component, involved in links that are accounted for by legislation.

We found no differences in the mean values of links, documents and agencies between ecosystem component groups (Kruskal-Wallis test, $P > 0.05$, Table 3.2).

In 245 out of a total of 294 possible dyads of related components, they did not show any legislation-related link (i.e., gap) (Fig. 3.6, also see Annex 3.5). When we analyzed the number of gaps per single ecosystem component, we found that kelp, flagship species habitat, wildlife watching and diving areas from the ecosystem services group; maritime traffic, marine pollution, power plants, invasive species and climate change from the threats group, and MEABRs, MPAs and recreational diving from the uses/activities group had a higher number of gaps (Fig. 3.6). We found no differences in the mean values of gaps between ecosystem component groups (Kruskal-Wallis test, $P > 0.05$, Table 3.2).

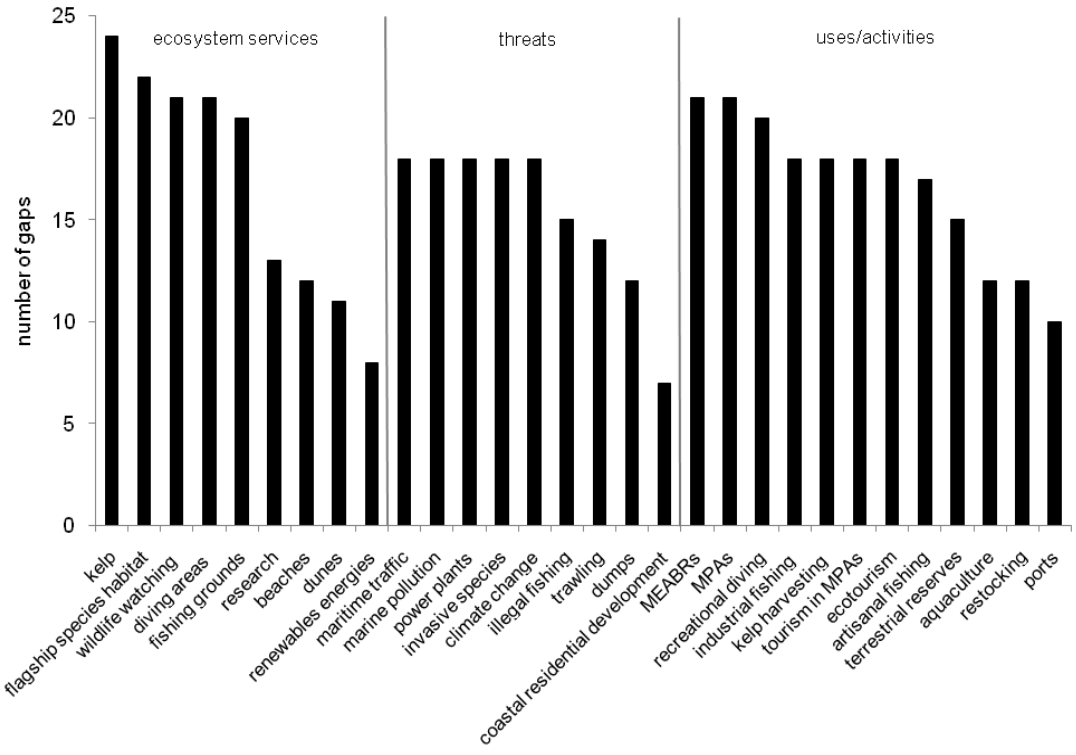

Fig. 3.6. Gaps per ecosystem component.

The overall degree of potential fit between legislation and the ecosystem model was $M = 0.17$. The highest M values observed for the ecosystem services group were beaches and research (0.43 and 0.41, respectively), for the threats group, marine pollution (0.28), and for the uses/activities group, aquaculture and ports (0.4 and 0.38 respectively) (Fig. 3.7).

Although M values for the ecosystem services group (0.17 ± SD 0.17) and uses/activities group (0.19 ± SD 0.14) were higher than for the threats group (0.07 ± SD 0.09), the high intra-group variability caused statistical analysis to fail in detecting significant differences between groups (Kruskal-Wallis test, P >0.05, Table 3.2).

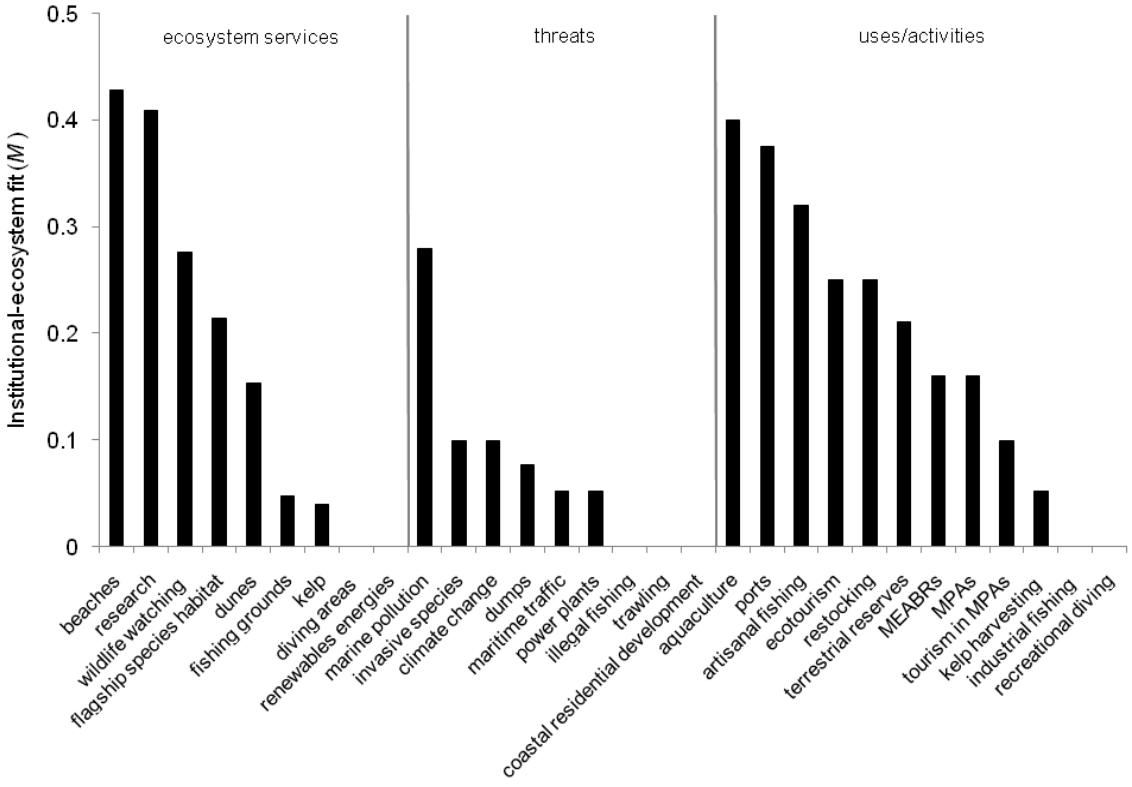

Fig. 3.7. M index (degree of fit between document collection and the ecosystem model) for each ecosystem component (higher values indicate greater fit).

Table 3.2. Summary of MINOE results. Links (accounted for by Chilean legislation) that the ecosystem components maintain with one another. Documents and agencies indicate ecosystem components involved in links that are accounted for by legislation. Gaps correspond to ecosystem modeled links that do not co-occur within documents. *M* index indicates institutional-ecosystem fit. Values represent mean ± one standard deviation per ecosystem components group.

	ecosystem services	threats	uses/activities
Links	4 ± 3.9	1.6 ± 2.2	3.9 ± 2.8
Documents	7.1 ± 7.9	2.3 ± 3.8	7.9 ± 8.7
Agencies	16.4 ± 14.9	2.9 ± 3.4	15.7 ±14.2
Gaps	16.9 ± 5.8	15.3 ± 3.8	16.7 ± 3.7
M index	0.17 ± 0.17	0.07 ± 0.09	0.19 ± 0.14

3.4.3. EBM in Chilean legislation

Table 3.3 shows general features and elements of EBM that were present in 16 instruments applicable to marine and/or coastal planning and management. The instruments have a high heterogeneity in the spatial implementation scale as well as in their creation and implementation age. Regarding the presence of elements of EBM considering the categories of management goals, ecological criteria and planning process, the instruments which scored most highly were the protected areas, with MU-CMPA showing the highest score. By incorporating the category management system, which is not applicable to all instruments because they do not explicitly consider a management plan or the plan has not yet been designed, the instrument MEABR joined the group of protected areas as one of the highest rated.

Table 3.3. EBM elements present in the main instruments associated with the planning and management of marine and/or coastal resources. For the spatial scale of implementation, s: small size, m: medium size, b: big size. For management goals, ecological criteria, planning process, management system, 1: low level presence, 2: medium level presence, 3: high level presence, -: not applicable, *only indicative instrument, **not yet implemented.

	Protected Areas						**Fisheries, Aquaculture or Maritime Use**					**Regional and Local Planning***				
	Marine Reserve	Marine Park	Native People Coastal Marine Areas**	MU-CMPA	National Reserve (terrestrial)	National Park (terrestrial)	Marine Resources Management Plan	MEABR	Aquaculture Suitable Areas	Aquaculture Concession	Maritime Concession	Coastal Zoning	Communal Development Plan	Communal Regulatory Plan	Regional Development Strategy	Territorial Planning Regional Plan
General features																
Spatial scale of implementation	s	m-b	s-m	m-b	s-m	m-b	m-b	s	s-m	s	s	b	s-m	s-m	b	b
Spatial planning incorporation	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	no	yes
Instrument age (years)	< 10	< 10	**	< 10	> 20	> 20	< 5	< 20	< 20	< 20	> 20	< 10	< 20	< 20	< 10	< 5
1. Management goals																
Diverse ecosystem goods and services provision	3	1	3	3	2	2	1	2	1	1	1	2	2	2	2	2
Sustainability	3	2	3	3	2	2	2	2	1	2	1	2	2	2	2	2
Ecological health	3	3	2	2	3	3	2	2	1	1	1	1	1	1	1	1
2. Ecological criteria																
Ecological complexity incorporation	2	2	2	3	2	2	2	2	2	1	1	1	1	1	1	1
Natural boundaries recognition	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
3. Planning process																
Relevant stakeholders involvement	2	2	2	3	2	2	3	2	1	1	2	2	2	2	2	2
Scientific disciplines involvement	2	2	2	3	3	3	2	2	1	2	2	2	2	2	2	2
Appropriate spatial scale	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2
4. Management system																
Management decentralization	2	1	3	2	2	2	2	3	-	1	1	-	3	3	-	-
Intersectoral cooperation	2	2	-	2	2	2	2	2	-	2	2	-	2	2	-	-
Science-based actions	3	3	-	3	3	3	3	3	-	2	1	-	1	1	-	-
Adaptive management	2	2	-	2	2	2	2	3	-	1	1	-	2	2	-	-
Integrated management	2	2	-	3	2	2	2	2	-	2	1	-	2	2	-	-
Total score 1 (1+2+3)	**18**	**16**	**18**	**21**	**18**	**18**	**16**	**16**	**11**	**10**	**11**	**13**	**13**	**13**	**13**	**13**
Total score 2 (1+2+3+4)	**29**	**26**	**-**	**33**	**29**	**29**	**27**	**29**	**-**	**18**	**17**	**-**	**23**	**23**	**-**	**-**

3.5. Discussion

3.5.1. Defining an ecosystem

An ecosystem model that is built from stakeholder valued ecosystem services allows us to integrate ecological and socio-economic dimensions in a manner that is conducive to decision-making by providing a common language for the various stakeholders. Determining the spatial scale for management planning is another challenge for EBM, and our study was based on a geographic area that was previously identified as a priority site for biodiversity conservation and proposed as an MU-CMPA. This area comprises a portion of two political-administrative regions that involve two regional governments, two communes and numerous centralized government agencies that operate under regional direction. The organizational structure in this scenario and the operation of any agency is too narrow to manage a larger geographic area. Spatial mismatches between governance scales and ecosystems are common (Crowder et al. 2006). Therefore, an area with stronger natural coherence with respect to its boundaries will be an organizational challenge for government agencies and governance systems.

3.5.2. Institutional fit and ecosystem

The links between the different components of the study model that are facilitated by legislation are scarce. The overall degree of potential fit between legislation and the ecosystem model revealed by the *M* index is lower than that found for different geo-political jurisdictions in the United States (Ekstrom & Young 2009), most likely because of progress that is occurring in some states towards EBM implementation (Ekstrom & Young 2009, McLeod &

Leslie 2009). In Chilean legislation, numerous ecosystem components do not co-occur with any other component. Among these, several correspond to components with a recent environmental valuation, and for which legislation is still emerging (e.g., diving areas and renewable energies), or they represent threats that are presently being dimensioned (e.g., trawling and coastal residential development). Most gaps were mainly components associated with habitat and biological communities (e.g., kelp, flagship species habitat, diving areas and MPAs). The highest number of links was found between components associated either directly or indirectly with economic development (e.g., beaches, research, marine pollution and aquaculture). In fact, aquaculture was the most frequent term in the document collection as a whole, which indirectly reflects the economic importance and high impact of this activity (Barton & Murray 2009) and the consequent generation of regulations that address it.

Central government agencies were the agencies most involved in the links (e.g., SUBPESCA, SERNAPESCA, both agencies of the Ministry of Economy, and DIRECTEMAR, from the Chilean Navy). Sectoral management (e.g., aquaculture, conservation, and shipping) operates under a different legal framework that reflects differing interests. Area governance can therefore be plagued by gaps or functional and regulatory overlaps. Andrade et al. (2008) state that Chilean territorial planning is not comprehensive but is compartmentalized because sectoral agencies are not necessarily coordinated. Laws and government agencies representing multiple levels and sectors are not designed to solve inter-sectoral conflicts (Crowder et al. 2006) and are therefore unable to adequately support the implementation of EBM (Österblom et al. 2010). An example of inadequate planning and lack of coordination was the latest sanitary crisis experienced by the Chilean salmon farming industry (Asche et al. 2010); the farm-based management model proved to be inappropriate and unable to cope with the crisis.

The results of the quantitative analytical method are an approximation to measure the gaps and functional fit between legislation and ecosystems; however, to verify potential gaps and links, qualitative methods such as legal analysis, interviews or key stakeholder focus groups can also be used (Ekstrom & Young 2009).

3.5.3. Opportunities for implementing EBM in Chile

Current Chilean legislation has no direct references with respect to the implementation of EBM; however, some law proposals or amendments to existing laws are currently being discussed in Congress to incorporate EBM (e.g., Fisheries and Aquaculture Law, Vulnerable Marine Ecosystems Law and the creation of a Biodiversity and Protected Areas Service). Another development is the GEF-Humboldt project to establish an EBM of the Humboldt Current LME, including a bi-national integration (Chile and Peru). However, these recent efforts do not solve the problem of EBM operability. The lack of frameworks that are able to facilitate the planning of the various activities that co-occur in marine and coastal areas (e.g., fisheries, aquaculture, MPAs and tourism) often results in a spatial and temporal overlap of activities and their objectives, resulting in conflict, lack of coordination between authorities and a lack of protection of ecologically significant marine and coastal areas (Douvere 2008).

Our assessment of instruments applicable to marine and coastal management and planning existing in Chilean legislation shows that several legal frameworks can be used as a basis for implementing EBM. Gelcich et al. (2009a) stated that the principles of EBM are not explicitly included in policies and plans concerning marine resource management in Chile; however, some local instruments, such as the Communal Development Plan, could support the

implementation of EBM principles. In the case of ecosystem management on a greater spatial scale and that involves several jurisdictional boundaries (e.g., communes or administrative regions), MU-CMPA appears to be the most suitable management measure, and it could support the implementation of EBM. Halpern et al. (2010) note the limitations of MPAs as a unique instrument to achieve EBM, but nevertheless, MU-CMPA in Chile aims to conserve biodiversity and cultural heritage, reduce conflict between users, promote scientific research and to develop low-impact commercial and recreational activities. MU-CMPA are homologous to the IUCN category VI protected areas and have been established by combining legal attributions of different ministries. The administration is public-private and involves regional governments and NGOs (Sierralta et al. 2011).

3.6. Conclusions

Although the relationships between the ecosystem model components (defined from the valuation of environmental components by stakeholders) are poorly represented by Chilean legislation, several instruments contain elements that characterize EBM. The MU-CMPA can be considered as a base instrument for the short-term implementation of EBM in Chile. Changes in governance systems toward EBM can be complex and time consuming; however, alternative instruments and legal frameworks can be used as a first approach.

Capítulo 4. Collaboration and knowledge networks in coastal resources management: how critical stakeholders interact for multiple-use marine protected area implementation[13]

[13] Cárcamo, P.F., Garay-Flühmann, R., Gaymer, C.F. Collaboration and knowledge networks in coastal resources management: how critical stakeholders interact for multiple-use marine protected area implementation. Ocean & Coastal Management. In review

4.1. Abstract

Recent studies have shown that social networks and their properties are key in the search for explanations for the success in the governance and management of natural resources. We investigated the structure and properties of inter-organizational social networks involved in the use and management of natural resources in a coastal marine ecosystem in northern Chile proposed as a possible marine protected area. We explored two configurations of networks: i) relations of collaboration (hereinafter collaboration network), and ii) relations of transfer and exchange of scientific knowledge and information useful to the management of natural resources and the decision-making process involved (hereinafter knowledge network). Both networks showed little cohesion, with low values of centralization and density indicating a low flow of collaborative and exchange relations among different stakeholders. The knowledge network achieved greater levels of centralization than the collaboration network. National government agencies and fishermen organizations were the most powerful stakeholders in the collaboration network. National government agencies and universities were the most powerful stakeholders in the knowledge network. We found a disconnected network when analyzing the flows of collaboration and knowledge between different administrative operation levels that potentially would hamper the governance of this area. On the other hand, we identified stakeholders (e.g., NGOs, Technical Consultants) that would help to connect the network (bridging stakeholders). Additional analysis of stakeholders using influence-capacity matrix allowed us to identify key stakeholders (e.g., Artisanal Fishermen Organizations, National Fisheries Service) for planning and implementing the new marine protected area, compare results with network analysis, and propose network interventions. We propose combining

Social Network Analysis with other methods of stakeholder analysis to produce more practical and implementable results. Our results are relevant for future interventions aimed at improving or implementing the management and governance of coastal areas.

4.2. Introduction

Ecosystem-based management (EBM) is promoted as an alternative to traditional approaches for managing natural resources (McLeod & Leslie 2009, Kidd et al. 2011). EBM corresponds to a place-based approach that considers the entire ecosystem and the connections between its various components, including the strong connections between social and natural systems, and focuses on maintaining the ecosystem in a healthy, productive and resilient condition so that it can provide the services that humans want and need (McLeod & Leslie 2009). For its implementation it has been proposed to create an adaptive and flexible management network, which means adopting organizational changes aiming to achieve: i) interdisciplinary collaboration across multiple levels, ii) involving stakeholders and considering their knowledge and opinions, iii) incorporating and sharing relevant scientific information, iv) integrating science and policies, and v) making collaborative decisions (Carollo & Reed 2010, Granek et al. 2010). Any region to be managed contains a range of stakeholders who are involved, interested, or affected by the decisions regarding natural resources management (Pomeroy & Douvere 2008). Indeed, many management and conservation initiatives fail because little attention is paid to the knowledge, relations, interests and characteristics of stakeholders (Prell et al. 2008). On the other hand, there is sufficient evidence showing that the acceptance, involvement, and early participation of the affected community in planning

and decision-making activities are key for effective implementation of marine conservation and management measures (Pomeroy & Douvere 2008, Rodríguez-Martínez 2008).

Next, to achieve good and effective governance in protected areas, institutional capacity and supportive contexts are needed (Lockwood 2010). Therefore, it is a crucial issue to investigate and develop the capacity amongst local resource users to sustainably manage natural resources and the capacity amongst relevant government authorities to enforce management decisions (Jones & Burgess 2005).

Stakeholder analysis (SA) is understood as a process that: i) defines components of a social and natural system affected by a decision or action, ii) identifies and describes individuals and groups who are affected by or can affect different components of the system (e.g., relations, interests, objectives), and iii) ranks and prioritizes these individuals and groups for involvement in the decision-making process (Pomeroy & Douvere 2008, Reed et al. 2009). Therefore, given the importance of the human system in EBM, SA is a key issue to be carried out prior to its implementation.

Social Network Analysis (SNA) adds to SA the study of social structure and the relations between key actors (Freeman 2004, Reed et al. 2009). SNA has been widely used by social scientists to explain various social phenomena (Borgatti et al. 2009). However, empirical research in natural resources management and environmental governance networks applying quantitative analysis is recent and scarce (Bodin & Crona 2009, Bodin & Prell 2011).

Social networks are part of the social structure that enables or hinders the different stakeholders to collaborate and solve problems related to natural resources (Pretty & Ward 2001, Grafton 2005, Marín & Berkes 2010, Bodin & Prell 2011). Recent research has shown that social networks and their structural properties affect collaborative processes and,

therefore, should be considered as key variables in the search for explanations for the success or failure in natural resources management (Bodin & Crona 2009, Ramirez-Sanchez & Pinkerton 2009, Marín & Berkes 2010, Bodin & Prell 2011, Cohen et al. 2012, Weiss et al. 2012). Identifying the structural properties of social networks is useful for understanding the power dynamics, knowledge and information exchange (e.g., traditional or scientific knowledge for management), and improving co-management arrangements to increase the adaptive capacity and resilience of social-ecological systems (Hughes et al. 2005, Bodin & Prell 2011, Weiss et al. 2012). Thus, SNA of management and governance of natural resources also becomes a valuable tool to examine the relations between stakeholders, to determine how different stakeholders are positioned within the network, and how relations are structured within the whole network. SNA can also be a tool to identify, select, and engage stakeholders in participatory processes associated with natural resources management (Prell et al. 2009, Bodin & Prell 2011, Vance-Borland & Holley 2011).

In the context of the transition of current governance systems towards approaches such as EBM, stakeholders and social network analysis can contribute to its implementation in particular areas identifying, among others, patterns and networks of scientific knowledge exchange and transfer, power networks, current and potential collaboration networks, key stakeholders to lead the implementation, thus providing inputs for the design or redesign of management plans.

This article investigates the structure and properties of inter-organizational social networks associated to the use and management of natural resources in a highly productive and biologically diverse coastal marine ecosystem hotspot in northern Chile. We explored two configurations of networks: i) relations of collaboration, and ii) relations of transfer and

exchange of scientific knowledge and information on natural resources, which is useful to their management or decision-making processes. By describing how organizations connect with each other (i.e., whole network structure, groups, positions and roles), we analyzed the potential of these networks to support the implementation and operation of a new marine protected area (MPA). Additionally, and to contrast with the results of SNA, we conducted a SA using influence and capacity of stakeholders as variables to identify and categorize key stakeholders for a MPA planning and implementation process. Finally we discussed the value and applicability of these tools in the context of governance and management of natural resources in coastal areas.

4.3. Methods

4.3.1. Study area and target population

The study area corresponds to a system of coastal islands in northern Chile (28° 54'S - 29° 45' S; Fig. 4.1) belonging to the transition region of the temperate Humboldt Current System (Thiel et al. 2007). Their ecological and fishing features have made it a very important area for both fisheries and conservation (Thiel et al. 2007, Luna-Jorquera et al. 2012). Marine and terrestrial areas have been established for biodiversity conservation and management of benthic resources (Cárcamo & Gaymer in press). Fishing is the main source of employment for the residents of the small coastal villages, however, in recent years due to tourism growth, fishermen have ventured into wildlife watching activities (Cárcamo & Gaymer in press). The possible installation of coal-fired power plants near these protected areas generated social conflicts and controversies for their location and incompatibility with existing uses and

biodiversity relevance (Cárcamo et al. 2011). Nowadays, potential conflicts are foreseen with mining ports projected to be built on the same coastline. In 2009 this area was defined as priority site for biodiversity conservation by the National Forestry Corporation and the National Fisheries Service, and in 2010 an NGO proposed the Chilean Government to evaluate the declaration of this area as a Multiple-Use Coastal Marine Protected Area (MU-CMPA).

Regarding the political-administrative division of Chile, the study area encompasses the coastal areas of Freirina commune (Huasco Province, Atacama Region) and La Higuera commune (Elqui Province, Coquimbo Region). Recently, Cárcamo et al. (2013) studied the same area and evaluated the functional fit between a conceptual ecosystem defined by stakeholders (and based on ecosystem services, threats and uses/activities) and the Chilean legislation related to coastal and marine resources planning and management. They found that the Chilean legislation rarely accounts for the relations defined between the different components of the ecosystem model, observing many gaps in legislation and a low functional fit potential. However, they noted that some existing instruments in the current legislation, such as MU-CMPA, can be used as a basis for short-term implementation of a management strategy based on the principles and criteria of EBM.

We focused our research on institutional interactions, considering individual representatives of organizations or institutions that are involved, interested or affected by initiatives of use, management and/or conservation of natural resources that occur in the coastal marine area of La Higuera and Freirina communes. Based on three information sources (conservation participatory committees meetings, protected areas advisory boards and operating committees, and names request to key informants) we triangulated (individuals or organizations cited in

two or three sources) and defined an initial group of twenty key informants to which we applied a questionnaire.

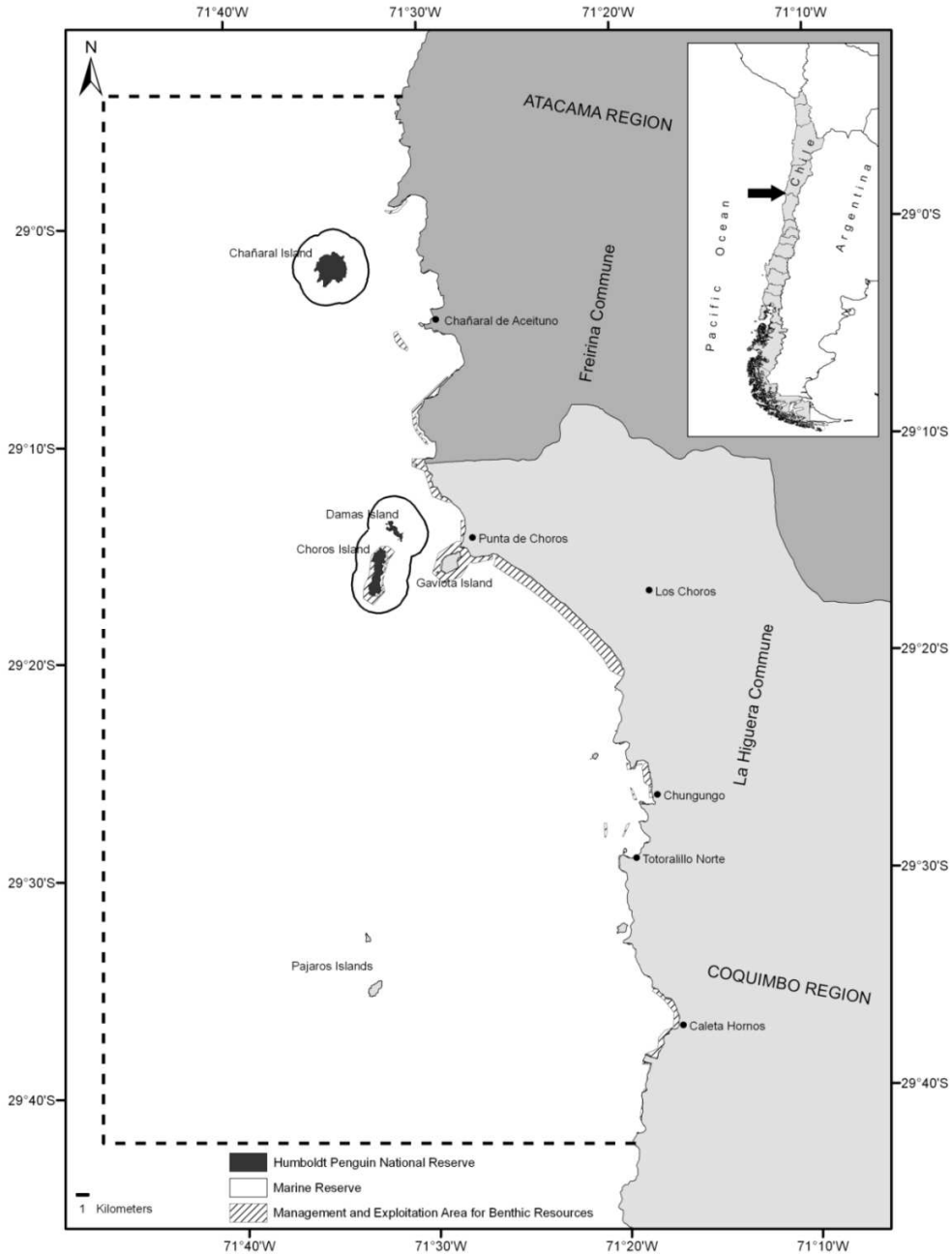

Fig. 4.1. Research area indicating the existing conservation and management areas. The dotted line indicates the area proposed as MU-CMPA.

4.3.2. Questionnaire design and data collection

To collect information from stakeholders, we designed a questionnaire with three sections: stakeholder background information, information to SA and SNA, and identification of new stakeholders. The first section included background information of each respondent and its organization. This information was arranged in an attribute matrix and permitted us to categorize stakeholders in three ways: organization type, administrative operation level, and if they are members of public-private committees or boards regarding management or conservation. The second section had three dimensions: perceptions on decision-making process, social networks, and stakeholders in MU-CMPA planning. In the first dimension, using a Likert scale statements (5-point scale ranging from not at all important to extremely important) we asked respondents to evaluate the participation of their organizations in the decision-making of natural resources management under two situations: i) in the current scenario, and ii) in the hypothetical scenario of implementing a MU-CMPA. In the second dimension, we asked respondents to indicate stakeholders with whom they have links in two fields: i) collaboration (hereafter collaboration network), and ii) exchange and/or transfer of scientific information and knowledge (hereafter knowledge network) in terms of use and management of natural resources. For both fields, we asked respondents to evaluate the importance level of collaboration and knowledge exchange (7-point importance scale from very low to very high), and determine the annual frequency of contacts (e.g., meetings or workshops per year). In the third dimension, we asked respondents to indicate which stakeholders they considered key to participate in the planning and implementation of MU-CMPA and to assess their influence and capacity in these activities (5-point scale ranging from

not at all to extremely influential). Influence was defined as the power a stakeholder has to facilitate or hamper the planning and implementation. Capacity was defined as a measure of available resources by an organization or institution (e.g., human, financial, knowledge, engagement systems) that potentially enable making the planning and implementation (Lockwood 2010).

In the third section, we asked respondents to indicate any other stakeholders they considered relevant to be surveyed considering their importance in terms of management of natural resources on the study area. This allowed us to validate the initial sample and, on an iterative process (Ritchie et al. 2003), adding new stakeholders to the study. As a criterion for including new stakeholders in the sample, they had to be mentioned by at least two other stakeholders.

The questionnaires were applied face to face to the initial group and the other stakeholders identified later, during November 2011 and December 2012. In two cases, by request of fishermen's leaders the survey was responded in presence of other fishermen members of the same organization.

4.3.3. Data analysis

4.3.3.1. Decision-making

Ordinal data from stakeholders' self-perceptions regarding participation in decision-making were tabulated to show the percentage of responses to each question for each scenario (current and hypothetical) and each stakeholder group. Wilcoxon Signed Rank test for dependent samples was performed to compare both scenarios. Differences among stakeholders groups were tested with a non-parametric Kruskal–Wallis test using rank sums instead of means (Zar

1996). Statistical analyses were carried out with R environment version 2.15.2 (R Core Development Team 2012).

4.3.3.2. Social networks measures

The SNA for the two network configurations were focused on individual level in complete networks, subgroups level and network level (Prell 2012). Survey answers were arranged in symmetrical matrices and depending on the type of analysis performed, we used matrices with valued data (i.e., considering valued relations) or binary data (i.e., considering only presence or absence of relation). Our data incorporated the directionality of links (i.e., directed data that distinguished the existence of reciprocity in the relations), however, some analyses required undirected data (i.e., not distinguished the existence of reciprocity) (Hanneman & Riddle 2005). Conversion to binary matrix from a valued matrix and all network analyses were performed using UCINET 6.0 software (Borgatti et al. 2002). Graph visualizations were performed using NETDRAW 2.0 (Borgatti 2002).

To assess how well the networks were connected and how the power and exchange was distributed among network actors we calculated the following network cohesion measures: i) density (the proportion of all possible links present in a network), ii) diameter (the longest number of steps between any two nodes, i.e., actors), iii) average path length (average number of steps between any two nodes), iv) in/out degree centralization (the extent to which one actor is holding all the links in the network), and v) betweenness centralization (the variation in the number of times that actors in the network lie on paths between other actors) (Hanneman & Riddle 2005, Vance-Borland & Holley 2011, Prell 2012).

To test the degree of association between collaboration relations and knowledge relations we used a correlation test (UCINET Quadratic Assignment Procedure Correlation, QAP) to develop standard errors to test for the significance of association (Hanneman and Riddle, 2005). The same test was used in both networks to evaluate whether the matrix for the importance level was positively associated with the matrix for annual frequency of relations.

Using type of organization and administrative operation level as grouping attributes, we calculated the E-I index (UCINET E-I Index function) that takes the number of links of group members to outsiders, subtracts the number of links to other group members, and divides it by the total number of links. This index ranges from -1 (all links are internal to the group) to +1 (all links are external to the group) (Hanneman & Riddle 2005). With a 5000-iteration permutation test we assessed whether the observed index value was significantly higher or lower than expected.

To identify single stakeholders that were potentially more strategic, influential and active than others, we calculated actor betweenness centrality and brokerage scores for each stakeholder. Betweenness centrality measures the potential control that an actor has over the flow of information in the network (Hanneman & Riddle 2005, Prell 2012). Brokerage scores can be used as a measure of bridging social capital (Vance-Borland & Holley 2011). To calculate brokerage scores we applied an analysis for brokerage according to Gould and Fernandez (1989), focusing on between-groups broker roles (UCINET G&F Brokerage Roles function). Using the administrative operation level as grouping attribute, this procedure allowed us, for each actor, to find the number of times that two actors belonging to different administrative operation levels were connected.

4.3.3.3. SA according to their influence and capacity

A code was assigned to each actor. We then calculated its relative frequency and the score assigned for capacity and influence. For categorizing stakeholders and identifying key stakeholders we constructed an influence-capacity matrix using the mean score achieved by each stakeholder. We used this matrix as an alternative to commonly used interest-influence prioritization and categorization matrices, where stakeholders are placed in a matrix according to their relative interest and influence (Reed et al. 2009).

4.4. Results

4.4.1. Stakeholders' identification

A total of 44 relevant stakeholders were identified for the use, management or conservation of natural resources in the study area, and 42 completed the survey (95 % response rate) (Table 4.1, full list available in Annex 4.1).

4.4.2. Participation in the decision-making process

Statistically significant differences were detected between the decision-making responses in both scenarios (Wilcoxon Signed Rank test, $Z= 3.2$, $P < 0.01$). In the current scenario, 88 % of respondents considered that participation of their organization in decision-making is moderate, very or extremely important. This percentage increased to 95 % in the hypothetical scenario of

implementing a MU-CMPA. 90 % of the respondents considered that their participation would remain unchanged or increase in terms of importance in the hypothetical MU-CMPA scenario, and only three stakeholders considered that their participation would decrease. For both scenarios, we found no statistical differences in participation in decision-making for the variables "type of organization or stakeholder" (Fig. 4.2) and "administrative operation level" (Kruskal-Wallis test, $P > 0.05$). When analyzed "belonging to public-private committee" as a grouping variable, in the current scenario, the participation of stakeholders involved in committees was higher than that of the stakeholders not involved (Kruskal-Wallis test, $H= 10.7$, $P < 0.01$). However, in the hypothetical MU-CMPA scenario, we found no statistical differences between both groups (Kruskal-Wallis test, $H= 2.25$, $P > 0.01$).

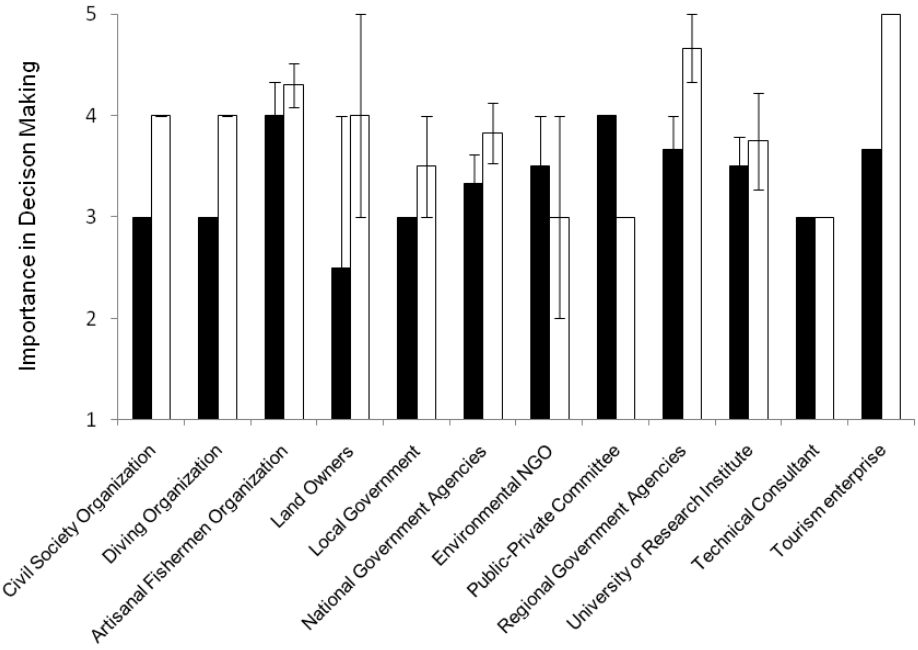

Fig. 4.2. Stakeholders' perceptions on the importance of their participation in the decision-making process for natural resources management at the study area. Values represent mean ± standard error in 5-point Likert scale by type of organization or stakeholder (ranging from "1, not at all important" to "5, extremely important"), black bars indicate the current scenario; white bars indicate the hypothetical scenario of implementing a MU-CMPA.

4.4.3. Collaboration and knowledge network analyses

The collaboration network registered 83 stakeholders and the knowledge network 62 stakeholders, being National Government Agencies, Artisanal Fishermen Organizations, and Environmental NGOs, the most represented (Table 4.1). The number of links was greater for the collaboration network than for the knowledge network. Stakeholders in the knowledge network matched in 92 % with stakeholders in the collaboration network. Diameter, average path length, and density showed similar values for both networks (Table 4.2). In-degree centralization showed similar values between networks and out-degree and betweenness centralization were greater for the knowledge network (Table 4.2) indicating that the knowledge flow was centralized in fewer stakeholders than in the collaboration network. The Quadratic Assignment Procedure Correlation (QAP) correlation was significant between both networks (Pearson correlation, $r= 0.522$, $P< 0.001$), suggesting a positive relation between the matrices that is unlikely to have occurred by chance, which indicates that the existence of collaboration relations between two stakeholders enhances the probability of knowledge exchange between them. Also we found a strong correlation between importance level of relations and their annual frequency ($r= 0.973$, $P< 0.001$ in the collaboration network; $r= 0.968$, $P< 0.001$ in the knowledge network) indicating that the valuation of the relation importance between two stakeholders was positively associated with the relation frequency.

Table 4.1. Surveyed stakeholders, stakeholders named in social networks, and key stakeholders in MU-CMPA planning and implementation. Classification was made by type of organization, administrative operation level and belonging to public-private committees associated to management or conservation of natural resources. For MU-CMPA planning and implementation, stakeholders were named in general way without specifying a particular organization (e.g., fishermen organizations) or administrative operation level.

	Abbreviation	Surveyed	Collaboration network	Knowledge network	MU-CMPA Planning
Type of Organization					
Civil Society Organization	CSO	1	3	1	2
Diving Organization	DOR	1	1	1	1
Local elementary school	EDUC	-	1	1	-
Artisanal Fishermen Organization	AFOR	10	13	13	1
Land Owners	LAND_OWN	2	2	2	1
Local Government (Municipality)	LOG	2	2	2	1
National Gov. Funding Agencies	NAG_FUND	-	8	2	1
National Government Agencies	NAG	12	22	13	11
Environmental NGO	NGO	2	9	7	2
National Police	POLICE	-	1	-	1
Public-Private Committee	PPC	1	4	4	2
Regional Government Agencies	REG	3	4	4	3
University or Research Institute	RES	4	6	7	2
Technical Consultant	TCO	1	3	1	1
Tourism enterprise	TOUR	3	4	3	1
Industrial Fishermen Organization	IFOR	-	-	1	1
Administrative Operation Level					
Atacama Region		9	18	12	
Coquimbo Region		28	46	38	
National or more than one region		5	19	12	
Public-Private Committee					
Yes		18	19	19	
No		24	64	43	
Total		42	83	62	31

Table 4.2. Measures of cohesion* for whole networks.

Measure	*Collaboration Network*	*Knowledge Network*
Network size	83	62
Number of ties	410	207
Diameter	8	8
Average path length	5.39	5.41
Density (%)	6	5.5
Indegree centralization (%)	21.32	18.06
Outdegree centralization (%)	23.82	31.61
Betweenness centralization (%)	6.80	12.60

* based on binary and directed data except average degree based on undirected data.

The E-I index results are shown in Table 4.3. When groups were defined by type of organization, the collaboration and knowledge networks showed similar observed values (0.665 and 0.693, respectively), indicating that the proportion of external links (between groups) was higher than the proportion of internal links (within groups). However, observed values were not statistically different to expected values (P= 0.031 and 0.103, respectively). When groups were defined by administrative operation level, again the collaboration network and knowledge network showed similar observed values (-0.305 and -0,284, respectively), indicating that the proportion of internal links was higher than the proportion of external links. Observed values were significantly different to expected values ($P < 0.001$ for both networks), indicating a strong within-groups cohesion.

Stakeholders holding best betweenness centrality values are shown in table 4.4. In the collaboration network, higher scores (i.e., stakeholders that more times lay between two others who are themselves disconnected) were achieved by National Government Agencies,

corresponding to the regional offices of the National Fisheries Service, followed by the National Forestry Corporation (both regional offices), one Artisanal Fishermen Organization located at La Higuera commune (Coquimbo Region), and one Artisanal Fishermen Organization located at Freirina commune (Atacama Region). In the lower part of the table we found one Regional Government Agency, the Fisheries Zonal Council that operates in both administrative regions, one Tourism Enterprise that operates at La Higuera commune, one Artisanal Fishermen Federation (grouping several fishermen organizations), and one Regional University located at the Coquimbo Region (Fig. 4.3).

Table 4.3. Whole networks E-I index*, using type of organization and administrative operation level as stakeholder`s grouping attributes.

	Observed values			Expected value**	
	Internal	External	E-I index	E-I index	P ≤ Observed
Collaboration network					
Type of organization	0.168	0.832	0.665	0.757	0.031
Administrative operation level	0.653	0.347	-0.305	0.201	0.001
Knowledge network					
Type of organization	0.153	0.847	0.693	0.773	0.103
Administrative operation level	0.642	0.358	-0.284	0.139	0.001

* based on binary and undirected data
**A 5000-iteration permutation test was used to assess whether the observed index value was significantly higher or lower than expected.

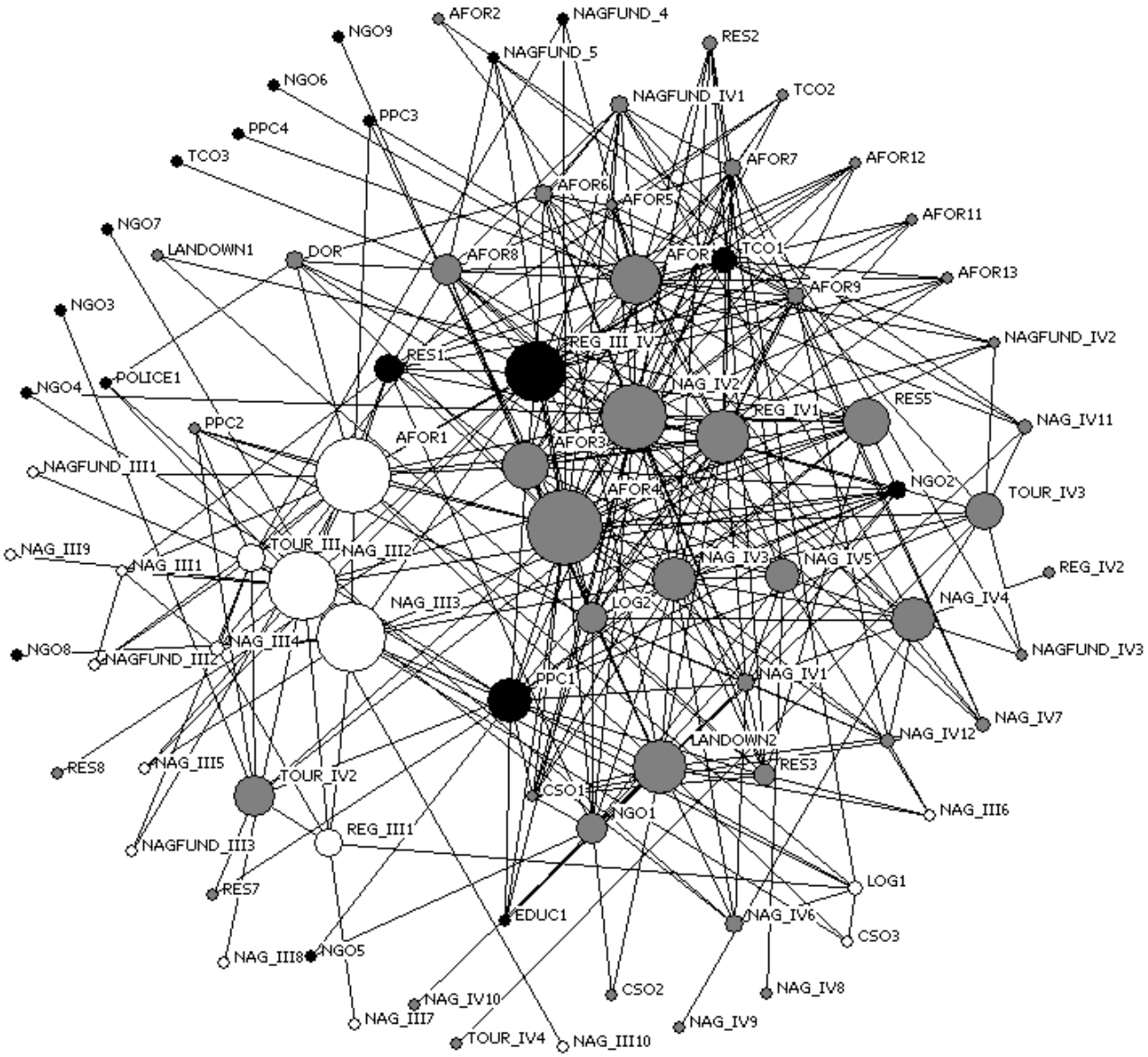

Fig. 4.3. Collaboration network representing collaboration relations among stakeholders, for natural resources management at the study area. Graph based on multidimensional scaling (MDS) ordination, relations are represented by lines (not considering relation directionality), nodes were colored depending on the administrative operation level of each stakeholder (white circle: Atacama Region, grey circle: Coquimbo Region, and black circle: National or more than one region), size of each node positively correlates with the betweenness centrality value for each stakeholder (larger node indicating higher betweenness). Nodes were labeled according to organization type. See Table 4.1 and Annex 4.1 for stakeholder's names and abbreviations. Arabic numerals indicate a specific type of institution or organization. A same Arabic numeral and different Romans numerals indicate the same institution but in different administrative regions.

In contrast to the collaboration network, in the knowledge network the highest scores were achieved by the National Fisheries Service Coquimbo regional office, a private Technical Consultant associated to fisheries management, the Fisheries Development Institute (a national institute dedicated to research in fisheries and aquaculture), and one Regional University with emphasis in marine research, located in the Coquimbo Region (Table 4.4, Fig. 4.4). Showing a lower score appeared the National Forestry Corporation Coquimbo regional office, the National Fisheries Service Atacama regional office, and another Regional University located at the Coquimbo Region but with emphasis in terrestrial research. In the lower part of the table we found a regional Environmental NGO that mainly works at La Higuera commune, the Coquimbo Regional Undersecretary of Environment depending of Environment Ministry, and one Artisanal Fishermen Organization located at La Higuera commune. Both networks, matched only in a 50 % when we compared stakeholders holding top 10 betweenness values.

The stakeholders holding the best brokerage values using administrative operation level as a grouping attribute are shown in table 4.5. In the collaboration network, the highest scores (i.e., stakeholders that more times connected two actors from different administrative operation levels) matched in 60 % with stakeholders holding top 10 betweenness values. The Fisheries Zonal Council achieved the first place. Compared to the betweenness analysis, we could notice the incorporation of the Fisheries Development Institute, a private Technical Consultant, and an International Environmental NGO, and the absence of Coquimbo regional office of the National Fisheries Service. In the knowledge network, only six stakeholders achieved brokerage scores, being one a private Technical Consultant, three Universities or Research Institutes, one Artisanal Fishermen Organization of Freirina commune, and the

Atacama regional office of National Forestry Corporation. In both networks, the main bridging stakeholders were not National Government Agencies (Table 4.5).

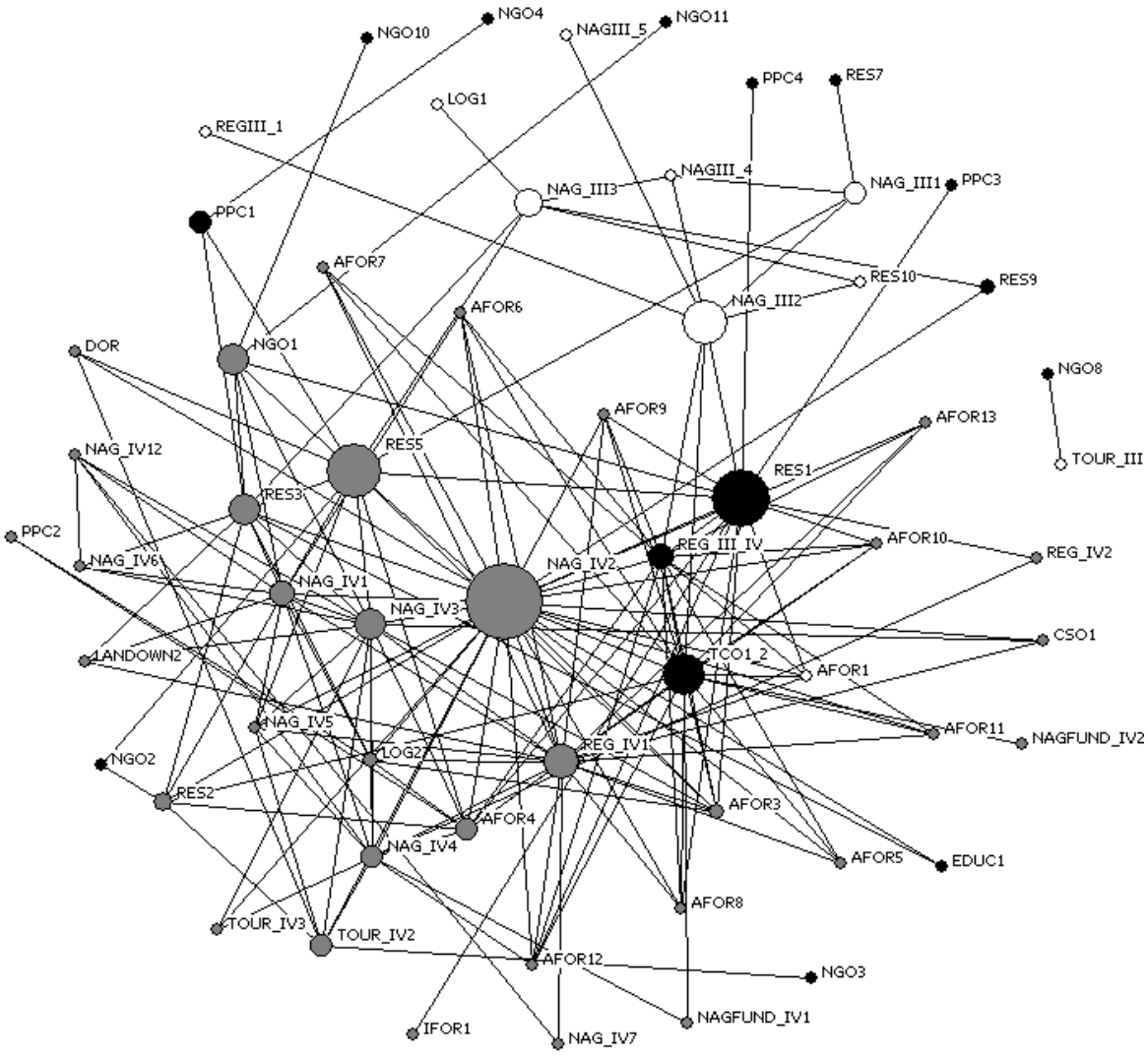

Fig. 4.4. Knowledge network representing relations of exchange and/or transfer of scientific information and knowledge for natural resources management among stakeholders at the study area. Graph based on multidimensional scaling (MDS) ordination, relations are represented by lines (not considering relation directionality), nodes were colored depending on the administrative operation level of each stakeholder (white circle: Atacama Region, grey circle: Coquimbo Region, and black circle: National or more than one region), size of each node positively correlates with the betweenness centrality value for each stakeholder (larger node indicating higher betweenness). Nodes were labeled according organization type. See Table 4.1 and Annex 4.1 for stakeholder's names and abbreviations. Arabic numerals indicate a specific type of institution or organization. A same Arabic numeral and different Romans numerals indicate the same institution but in different administrative regions.

Table 4.4. Normalized betweenness centrality scores* by individual level. List of top 10 betweenness scores stakeholders. See Table 4.1 for stakeholder's names and abbreviations. In organization name, Romans numerals indicate administrative operation level, III and IV correspond Atacama Region and Coquimbo Region respectively; Arabic numerals indicate a specific type of institution or organization.

ID	Organization name	*Collaboration network*	ID	Organization name	*Knowledge network*
NAG_IV_2	National Fisheries Service IV	7.611	NAG_IV_2	National Fisheries Service IV	13.860
NAG_III_2	National Fisheries Service III	6.146	TCO_1	Technical Consultant 1	13.777
AFOR_4	Artisanal Fishermen Organization 4	5.585	RES_1	Fisheries Development Institute	9.102
NAG_IV_3	National Forestry Corporation IV	5.350	RES_5	Regional University 5	6.775
AFOR_1	Artisanal Fishermen Organization 1	5.118	NAG_IV_3	National Forestry Corporation IV	5.918
NAG_III_3	National Forestry Corporation III	4.527	NAG_III_2	National Fisheries Service III	5.847
REG_III_IV	Fisheries Zonal Council	4.367	RES_3	Regional University 3	4.977
TOUR_IV_3	Tourism Enterprises IV	3.558	NGO_1	Regional Environmental NGO 1	4.035
AFOR_10	Artisanal Fishermen Federation 10	2.761	NAG_IV_1	Undersecretary of Environment IV	4.007
RES_5	Regional University 5	2.495	AFOR_4	Artisanal Fishermen Organization 4	3.806

* based on binary and directed data

Table 4.5. Un-normalized Brokerage scores* by individual level in collaboration and knowledge networks, using administrative operation level as stakeholder`s grouping attribute. List of top 10 brokerage scores stakeholders. See Table 4.1 for stakeholder's names and abbreviations. In organization name, Romans numerals indicate administrative operation level, III and IV correspond Atacama Region and Coquimbo Region respectively; Arabic numerals indicate a specific type of institution or organization.

ID	Organization name	*Collaboration network*	ID	Organization name	*Knowledge network*
REG_III_IV	Fisheries Zonal Council	43	TCO_1	Technical Consultant 1	32
RES_1	Fisheries Development Institute	24	RES_1	Fisheries Development Institute	22
TCO_1	Technical Consultant 1	16	AFOR_1	Artisanal Fishermen Organization 1	4
AFOR_1	Artisanal Fishermen Organization 1	12	RES_3	Regional University 3	2
RES_5	Regional University 5	9	RES_5	Regional University 5	2
NGO_2	International Environmental NGO 2	6	NAG_III_3	National Forestry Corporation III	1
AFOR_4	Artisanal Fishermen Organization 4	5			
NAG_III_2	National Fisheries Service III	5			
NAG_III_3	National Forestry Corporation III	4			
PPC_1	National Reserve Advisory Council	3			

* based on binary and directed data

4.4.4. Influence-capacity matrix

Respondents indicated 31 stakeholders (regardless the operation region) as key to participate in planning and implementation of the MU-CMPA, the most cited being those belonging to eleven national government agencies (Table 4.1). Artisanal Fishermen Organizations and National Fisheries Service were mentioned by 86 % of the surveyed stakeholders. 50 to 60 % of the stakeholders mentioned three National Government Agencies (Direction of Maritime Territory, Environment Ministry and National Forestry Corporation), the Regional Governments, Municipalities, and Universities. When we placed stakeholders in the matrix according to the mean score obtained, and when we incorporated the times that each actor was mentioned by another as a third score, these stakeholders were the most relevant in terms of influence in the area and had the greatest capacity to do the planning and implementation of the MU-CMPA. The exception were Municipalities that obtained a lower score on capacity (Fig. 4.5). Of the total stakeholders, 65 % achieved high scores of influence and capacity.

4.4.5. Comparison of stakeholders selected by different analysis

When comparing the top 10 most named stakeholders as key in the planning of the MU-CMPA with the top 10 highest betweenness scores stakeholders, we found that matching was higher with the collaboration network than with the knowledge network (60 and 50 %, respectively, Table 4.4, Fig. 4.5). However, organizations such as Municipalities, Regional Governments, Civil Society Organizations and the Direction of Maritime Territory which were

highly cited for MU-CMPA planning, did not appear among the best betweenness and brokerage scores.

Fig. 4.5. Influence-capacity matrix. Stakeholders were indicated as key to participate in the MU-CMPA planning and implementation. Positions corresponded to the mean score (5-point scale ranging from very low to very high) assigned by surveyed stakeholders to each stakeholder for capacity level to perform the planning and influence level in the area and on other stakeholders. Terms size is proportional to the number of times that each stakeholder was named by another stakeholder.

AFOR: Artisanal Fishermen Organizations, ALS: Agriculture and Livestock Service, DC: Diving Centers, DMT: Direction of Maritime Territory, DPW: Direction of Port Works, FDI: Fisheries Development Institute, FZC: Fisheries Zonal Council, I_NGO: International NGOs, LCOM: Local communities, L_OWN, Land Owners, MIN-E: Environment Ministry, MIN_H: Housing Ministry, MIN_NA: Ministry of National Assets, MPA_B: Marine Protected Areas Boards, MUN: Municipalities, NA: Neighborhood Associations, NFC: National Forestry Corporation, NFS: National Fisheries Service, NTS: National Tourism Service, PA_B: Terrestrial Protected Areas Boards, RCCB: Regional Commission of Coastal Border, RG: Regional Government, R_NGO: Regional NGOs, TE: Tourism Enterprises, TCO: Technical Consultants, UN: Universities.

4.5. Discussion

4.5.1. Perceptions on participation in the decision-making process

The self-perception regarding participation in decision-making was high, even in groups that have historically been negatively discriminated in terms of citizen participation and decision-making, such as artisanal fishermen and civil society organizations. An explanation for this perception can be found in the organization and collaborative work developed in recent years by some Chilean fishermen organization around management areas for benthic resources (Gelcich et al. 2005, Schumann 2007). The hypothetical declaration of a MU-CMPA in the study area generates a wide interest to participate in the decision-making process, which could be seen as a positive valuation of the participation in the implementation of a MPA and a recognition of the potential benefits derived from this (Cárcamo et al., unpublished data).

4.5.2. Collaboration and knowledge network analyses

In our study, SNA as a diagnostic tool provided two main contributions: 1) the structure and properties of collaboration and knowledge networks in the area, and 2) the extent to which these networks matched with the spatial scale of the natural ecosystem to intervene. As whole networks, both showed little cohesion, with low values of centralization and density indicating the existence of a low flow of collaborative and exchange relations among different stakeholders. Some disadvantages resulting from low density are a limited spread of information, higher transaction costs associated to exchange and decision-making capabilities, low capacity for collective action, and limited resilience of the system (Janssen et al. 2006,

Bodin & Crona 2009, Weiss et al. 2012). A decentralized network can be inefficient in coordination to solve simple tasks, forming groups, and building support for collective action in initial phases, however, it is more advantageous for long-term planning and solving complex tasks (Janssen et al. 2006, Prell et al. 2009). Additionally, in decentralized networks the participation can be perceived as more fair and open, and they are more robust when nodes are removed (Janssen et al. 2006).

The asymmetry in the number of stakeholders per region (i.e., greater at the Coquimbo Region) can be explained by the greater number of management and conservation measures and of institutions dedicated to management and research (e.g. regional universities) existing in this part of the study area. While both networks share some similar cohesive properties (e.g., density, diameter, in-degree centralization), the number of nodes of the collaboration network is greater than those of the knowledge network, probably explained by the nature of the production, dissemination and exchange of knowledge, which is generally more restricted and requires a higher level of expertise and technical skills (Weiss et al. 2012). The latter can also be corroborated by the greater level of centralization in the knowledge network, which indicates that the knowledge exchange is brokered by fewer stakeholders.

The high presence of fishermen organizations in the collaboration network and their high scores of betweenness centrality indicated the social and economic importance of the fishing and management areas for benthic resources managed by them. In the knowledge network, they decreased their presence in the high scores, and in contrast universities and research institutes become important. In the latter network, technical consultants (private institutions which advise technically and scientifically to fishermen and have played a relevant role in Chilean co-management regime for shellfish (Schumann 2010) also appeared.

The National Fisheries Service and the National Forestry Corporation showed key positions according to betweenness centrality and in both networks and administrative regions (Atacama and Coquimbo). Although their original function was more associated with the enforcement of fishing and forestry laws, they are presently national agencies responsible of managing marine reserves and terrestrial protected areas, respectively. The power of the National Fisheries Service in collaborative networks in marine environments is also recognized in other regions of Chile (Marín & Berkes 2010). Government agencies that work with natural resources are not direct producers of scientific knowledge, but they achieve relevant positions in the knowledge network, indicating a potential role as bridging actors connecting producers and consumers of knowledge. The local governments (i.e., municipalities) were not positioned as key or relevant in either network, revealing their secondary role in decision-making and in the resources flow. In the last decades, Chile has experienced various regionalization and decentralization reforms (Mardones 2006), but possibilities for intervention in territorial planning and in the coastal border zoning are scarce for communes (i.e., local government), and there is still a strong dependence on national or regional governments (Fløysand et al. 2010).

When we used type of organization as stakeholder`s grouping attribute (i.e., E-I index), for both networks we found that the proportion of links between groups was higher than the proportion of ties within groups, although observed values were not statistically different from expected values. In general, there were no disconnected groups. In contrast, when we used the administrative operation level as stakeholder`s grouping attribute, we found a high within-group cohesion, meaning that the interaction and flow was very low between different regions stakeholders (even between counterpart government agencies), condition that was expected

given the current Chilean political-administrative division. From the perspective of the governance of social-ecological systems, we could point out that there is a spatial and operational mismatch between institutions or management regimes and natural ecosystems (Paavola et al. 2009), where current governance systems represented in part by some government agencies and their regional offices do not match with the extent of the coastal ecosystem characterized by the islands system. Another finding worth mentioning is that certain types of organizations, such as fishermen organizations and government agencies achieved low levels of within-group cohesion. Also, Marín and Berkes (2010) found little horizontal exchange and cooperation among fishermen organizations of central Chile. In the case of sectoral government agencies, the traditional focus on single resources has created institutional structures with compartmentalized decision-making processes, leading to instruments and policies that undermine sustainability. An example of this is indicated by Andrade et al. (2008): the Chilean territorial planning is not integrated but compartmentalized, as dictated by sectoral agencies which are not necessarily work coordinated. As pointed by Crowder et al. (2006), laws and government agencies on multiple levels and sectors are generally not designed to solve inter-sectoral conflicts, thus they do not adequately support the implementation of strategies such as EBM.

4.5.3. What kind of network do we need to manage a MU-CMPA? Selecting stakeholders for their implementation

In Chile MU-CMPAs have been established combining legal attributions of different ministries and its administration is proposed to be public-private, involving regional

governments and NGOs (Sierralta et al. 2011). An area proposed as MU-CMPA will require a governance and management approach that copes with new economic challenges (e.g., ports, mining, touristic development) and environmental threats (e.g., species mortality, pollution, climate change), but also with traditional activities such as artisanal fishing (Cárcamo et al. 2013). The search for a better approach to ensure sustainability has to acknowledge ecosystems as complex dynamic systems and address the mismatch between social systems and ecosystem. Governance approaches such as adaptive management and adaptive co-management are suggested for the implementation of EBM (Arkema et al. 2006, Österblom et al. 2010, Berkes 2012). Co-management has evolved from dyadic conception (e.g., state and local community) to a complex network of actors from different organizations and hierarchical levels connected through institutional arrangements, resources dependence and information exchange (Carlsson & Berkes 2005, Bodin & Prell 2011). For this purpose, when thinking in the governance and management of an area comprising different communes and administrative regions is crucial to improve the flow and exchange of knowledge and collaboration among stakeholders of different administrative operation levels, between groups and within-groups. In this context, the role of bridging actors in linking disconnected segments will be crucial. Bodin and Crona (2009) indicated that the positive effect of bridging links in natural resource governance extends beyond the provision and exchange of resources of various kinds, fostering trust among previously unconnected groups and facilitating collective actions. In our study, powerful stakeholders such as some National Government Agencies (e.g., National Fisheries Service and National Forestry Corporation) were important in both networks, indicating that they can connect the two systems (i.e., collaboration and knowledge), probably reducing costs of collaboration and provision of information and

knowledge between groups. On the other hand, more central and powerful stakeholders did not necessarily act as bridging actors between the different administrative scales. Indeed, bridging stakeholders were generally not National Government Agencies, indicating the important role of private and non-governmental organizations (e.g., NGOs, technical consultants, universities and fishermen organizations) and regional agencies. These latter stakeholders can play a crucial role in consolidating the exchange circuit, from the acquisition of new information and scientific (e.g., university) and traditional (e.g. fishermen) knowledge to the implementation (e.g., fishermen, enforcement agencies, decision makers), including the feedback processes. This is very relevant if we considered that one of the main elements of EBM is science-based management (McLeod & Leslie 2009). The existing knowledge network and the possibility of improving it will have a strong influence in the management outcomes. Weiss et al. (2012) pointed out that bridging organizations can be most effective if they exist at the appropriate administrative scale and if their role as facilitators is stated in their institutional mandate.

Stakeholders' perceptions regarding who should be involved in MU-CMPA planning and implementation, point to the need of incorporating stakeholders such as local and regional governments, and civil organizations, however, the latter are currently in peripheral positions in both networks. Networks are not static and their properties can change; indeed, stakeholders and their relations (nodes and links) can sometimes be activated and deactivated. Maintaining the activation capability of nodes and links is an important property that can contribute to the system resilience and to face up times of crisis (Janssen et al. 2006).

Theoretically institutions such as government can help or promote the construction of networks with favorable structural properties to the management, but there are stories of

relations and conflicts that should not be ignored. Bodin and Crona (2009) give some tips to achieve this: provide arenas for interaction, develop participatory processes, and provide funding for coordinators or facilitators.

4.5.4. Using SA in the real world

Tools such as SNA may go beyond an academic exercise and assist in the decision-making process for natural resources (Bodin & Prell 2011, Vance-Borland & Holley 2011).

Our research is an approach to the study of networks in the social-ecological system that we have defined as associated to a future MU-CMPA, addressing only some of the existing network configurations. We characterized the existing situation in terms of relations patterns and we found strategic actors or groups (and also we could use this kind of analysis to assess the long-term evolution of networks). The use of additional tools (e.g., matrices) allowed us to make comparisons and suggest the incorporation of new actors to the future network. To categorize stakeholders and investigate relations between them, we consider useful to combine SNA with other methods or tools of SA such as interest-influence matrices, stakeholder-led stakeholder categorization, among others (Reed et al. 2009), to produce more practical and implementable results. Our study can be relevant for interventions aimed to improving or implementing governance of multiple-use areas under EBM principles.

Capítulo 5. Using stakeholders' perspective of ecosystem services and biodiversity features to plan a marine protected area[14]

[14] Cárcamo, P.F., Garay-Flühmann, R., Squeo, F.A., Gaymer, C.F. Using stakeholders' perspective of ecosystem services and biodiversity features to plan a marine protected area. Environmental Science & Policy. In review.

5.1. Abstract

The definition of a common vision that includes social and environmental goals, ecosystem services and/or biodiversity features that people are interested in maintaining or restoring is a great challenge for marine protected areas (MPAs). Recent initiatives have promoted broadening the focus from biodiversity conservation alone to the conservation of both ecosystem services and biodiversity, indicating that this integration should improve support and compliance from stakeholders. Using a Multiple-Use Coastal Marine Protected Area recently proposed in northern Chile, we investigated i) stakeholders' perceptions of the valuation of ecosystem services, threats to their provision, and the prioritization of ecosystem services, biodiversity features, and uses in a planning scenario, and ii) stakeholders' expectations for the establishment of a new MPA. The perceptions of different groups of stakeholders were compared and statistically analyzed, and the relationships among prioritizations were studied using a network approach. Stakeholders identified and valued 13 ecosystem services, 28 biodiversity features, 20 uses and activities, and 22 threats. Significant differences among the valuations and prioritizations of different stakeholder groups were attributable principally to artisanal fishermen's perceptions of some components that are directly related to their activities and livelihoods. High expectations of benefits from a new MPA implementation were observed for all categories of stakeholders. To relate the different valuated components, we propose a network-based conceptual model that reduces complexity and as a strategy to communicate relationships and trade-offs occurring in this particular social-ecological system to the several stakeholders. We strongly recommend early stakeholder engagement so as to understand the variability in environmental perceptions and

then reflect that variation in the planning and management actions of MPAs, thus improving support for their implementation and achieving conservation and societal goals. Our findings indicate that stakeholders' perceptions and prioritizations of ecosystem services, biodiversity features and uses should be used as the basis for starting the MPA implementation and planning process.

5.2. Introduction

Marine Protected Areas (MPAs) are a widely used strategy with the principal aims of promoting fisheries management and biodiversity conservation (Roberts et al. 2005, Gaines et al. 2010). MPAs can also promote productive non-extractive activities such as ecotourism, thus playing an important role in diversifying local economies (Oracion et al. 2005, Charles & Wilson 2009). In recent years, MPAs have been considered an essential tool for implementing ecosystem-based management (EBM) of the oceans and coasts (Halpern et al. 2010, Hoelting et al. 2013). MPAs are implemented in different forms depending, for example, on their size and shape, the desired levels of restriction and regulation of their uses, the legal and institutional framework in the region or country, and the conservation goals (Hind et al. 2010, Agardy et al. 2011). MPA design can vary widely from full no-take marine reserves to multiple-use MPAs (Mangi & Austen 2008, Lester et al. 2009), but sometimes this variety of designs and nomenclatures can create unrealistic expectations regarding the level of and reasons for protection (Al-Abdulrazzak & Trombulak 2012).

The design of a new MPA should be based not only on knowledge of the physical and ecological systems that affect it but also on the human dimensions, including governance,

socio-economic, and cultural aspects (Charles & Wilson 2009, McLeod & Leslie 2009). The inclusion of the latter aspects can facilitate or hinder the implementation and success of a MPA (Rodríguez-Martínez 2008, Pollnac et al. 2010, Lopes et al. 2013). Within the human dimensions of MPA design, the identification and understanding of stakeholders, including their perceptions, attitudes, interests and expectations, are essential under ecosystem- or place-based approaches to management (Gelcich et al. 2005, Mangi & Austen 2008, Heck & Dearden 2012). The involvement and early participation of stakeholders in MPA planning processes, including the expectations and perceptions of the performance of a new MPA and the definitions of goals and targets, are key for an effective implementation and can also reduce conflicts, improve the MPA's effectiveness, provide a measure of the success of management, and gain support and acceptance from stakeholders (Pomeroy & Douvere 2008, Charles & Wilson 2009, Heck & Dearden 2012, Hoelting et al. 2013, Lopes et al. 2013, Pita et al. 2013). The definition of a common vision that includes social and environmental goals and ecosystem services or biodiversity features that people are interested in maintaining or restoring is a great challenge of MPA and EBM implementation (Leslie & McLeod 2007, Mangi & Austen 2008).

Ecosystem goods and services (i.e., the benefits human populations obtain directly or indirectly from ecosystem functions (Costanza et al. 1997)) that are essential for our well-being are provided by coastal and marine ecosystems (Beaumont et al. 2007). However, various anthropogenic pressures directly or indirectly impact ecosystem functioning and its capacity to provide these services (Worm et al. 2006). Use of the ecosystem goods and services (hereafter ES) concept is promoted as an approach to integrate the ecological and socio-economic dimensions in a way that is useful for decision-making (Farber et al. 2006,

Tallis et al. 2009). ES provides a common language to different stakeholders and can facilitate comparisons between management alternatives (Granek et al. 2010). Focusing management on ES rather than ecosystem functioning *per se* permits recognition and accounting for the physical, ecological, and social factors affecting the production and provision of these services (McLeod & Leslie 2009). ES valuation may involve both qualitative and quantitative analysis, from a conceptual representation of how human activities affect and depend on ecosystems to quantification of the monetary value of particular services (Granek et al. 2010, Nahlik et al. 2012). Qualitative assessments can be valuable for strategic decision-making processes, providing an overview and trends and identifying trade-offs between services, which subsequently requires an in-depth analysis (Busch et al. 2012). Ultimately, to achieve sustainable solutions and assist decision-makers in conservation planning and natural resource management, it is strongly recommended that a wide range of stakeholders and technical experts (e.g., in natural and social sciences) participate in the early stages of the assessment of the full range of benefits derived from an ecosystem, explicitly incorporating local human values and needs (Menzel & Teng 2010, Maynard et al. 2011, Nahlik et al. 2012).

Recent initiatives have promoted broadening the focus from the conservation of biodiversity features alone to the conservation of ES as well as biodiversity, indicating that this integration should increase support and resources for the implementation of conservation programs (Egoh et al. 2010, Reyers et al. 2012). The results obtained by Egoh et al. (2010) show that by including data on the ES provided by a terrestrial system, conservation plans can be far more efficient in selecting areas for both biodiversity and ES without additional costs. For setting conservation priorities based on ES or biodiversity or both, first, we need to identify biodiversity features (or ecosystem features that supply ES) that need protection or

management as well as the processes that threaten these features (Wilson et al. 2009). Next, we should consider the set of conservation actions required to conserve the biodiversity features (or to ensure the supply of ES) at particular locations and the associated costs (Wilson et al. 2009, Luck et al. 2012).

Considering that the early and clear identification and prioritization of conservation goals and stakeholder involvement in these processes are key elements towards the establishment of a MPA, we investigated stakeholders' perceptions of ES, biodiversity features, and the uses of and threats to their conservation in a coastal marine ecosystem in northern Chile recently proposed as a Multiple-Use Coastal Marine Protected Area (MU-CMPA).

Although stakeholder involvement and support for MPAs and stakeholders' perceptions of existing and proposed MPAs have recently been documented (Thomassin et al. 2010, Heck & Dearden 2012, Hoelting et al. 2013, Lopes et al. 2013), stakeholders' perceptions and identification of ecosystem services and conservation goals for planning a potential MPA are absent from the scientific literature.

The objectives of this study were to investigate the following: i) stakeholders' perceptions of the identification and valuation of ES and threats, ii) stakeholders' perceptions of the prioritization of ES, biodiversity features, and uses under a scenario of MU-CMPA planning, iii) stakeholders' expectations for the establishment of a new MU-CMPA, and iv) the relationships among the prioritizations and perceptions of different groups of stakeholders. To relate the different valued components, we propose a simple conceptual model that reduces complexity and allows the easy communication of outcomes. Finally, we discuss the value and applicability of including stakeholders' perceptions in the context of MPA planning and EBM for coastal areas.

5.3. Methods

5.3.1. Study area and stakeholders sample

The study area encompasses a small coastal islands system in northern Chile (28° 54' S - 29° 45' S; Fig. 5.1) that belongs to the transition zone of the Temperate Humboldt Current System (Thiel et al., 2007), including the coastal areas of Freirina commune (Atacama Region) and La Higuera commune (Coquimbo Region). In 2010, an NGO proposed this area as a possible MU-CMPA to the Chilean Government due to its great importance for biodiversity conservation and both artisanal and industrial fisheries (Thiel et al. 2007, Luna-Jorquera et al. 2012). The area includes terrestrial and marine biodiversity conservation areas as well as management and exploitation areas for benthic resources (MEABRs) (Cárcamo & Gaymer in press). Artisanal fishing is the main source of employment for residents of the small coastal villages, but as a consequence of tourism growth in recent years, some fishermen have diversified their income opportunities to include wildlife watching activities (Gaymer et al. 2008).

Our study focused on relevant stakeholders related to the use, management and/or conservation of natural resources on the area. Previously, Cárcamo et al. (in review) identified 44 relevant stakeholders (representatives of organizations or institutions). Finally, 42 stakeholders completed the questionnaire (95 % response rate) (Table 5.1). This study analyzed part of a larger questionnaire that also included stakeholder analysis and social networks analysis and was applied face-to-face in November 2011 and December 2012 (Cárcamo et al. in review).

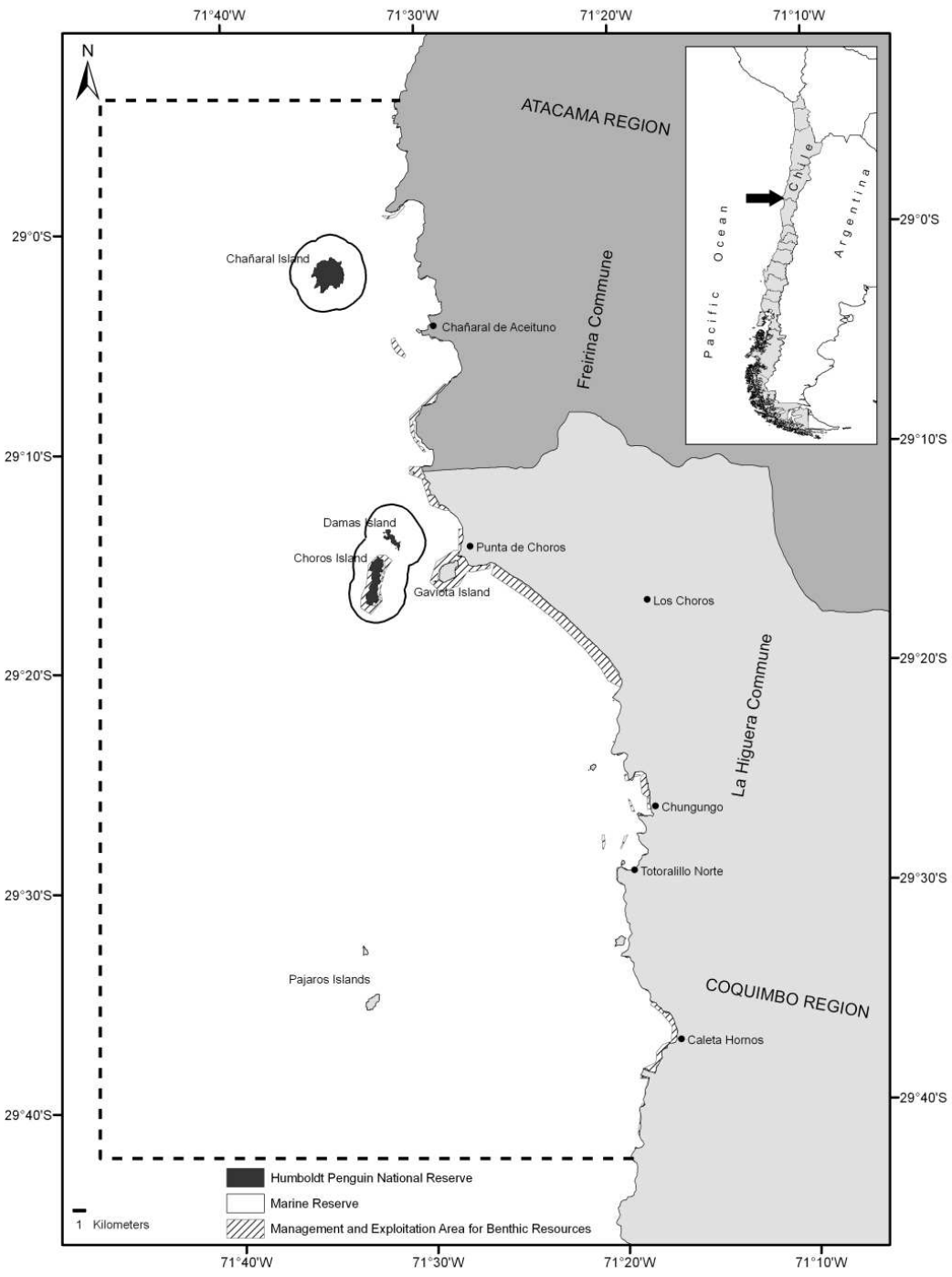

Fig. 5.1. Study area. The dotted line indicates the area proposed as a MU-CMPA.

Table 5.1. Classification of surveyed stakeholders according to organization category and natural resources user type.

	Abbreviation	N
Category of organization		
Artisanal Fishermen Organizations	AFOR	10
Land Owners	LAND	2
Local Government (Municipalities)	LOG	2
National Government Agencies	NAG	12
NGO and Civil Society Organizations	NGO	5
Regional Government Agencies	REG	3
Universities or Research Institutes	RES	5
Tourism enterprises	TOUR	3
Direct user		
Yes		15
No		27
Total		42

5.3.2. Questionnaire design and data collection

This part of the questionnaire included three sections: i) stakeholder background information; ii) valuation of ES, biodiversity, uses, and threats; and iii) expectations for the possible establishment of a MU-CMPA. To avoid misunderstandings or misinterpretations of concepts related to ES and biodiversity features, these concepts were explained to individual respondents prior to application of the questionnaire. *Section One*: Stakeholder background information. Background information on each respondent and his or her organization was requested and arranged in an attribute matrix to characterize stakeholders according to their organization (e.g., government/non-government, administrative operation level) and use (direct/indirect users).

Section Two: Valuation of ES, biodiversity, uses, and threats. This section had four dimensions: in the first dimension, valuation of ES, a list of ES (Table 5.2) previously identified for the study area[15] was presented to each informant. Using a 5–point scale, we asked respondents to first identify the existence of these ES in the area and then to evaluate them according to levels of presence (where 1: not at all present and 5: highly present) and importance (where 1: not at all important and 5: extremely important). Subsequently, we asked respondents to name the five ES they would prioritize to ensure or maintain their supply. In the second dimension, valuation of biodiversity features, we asked respondents to name the five primary biodiversity features to prioritize for conservation efforts. In the third dimension, valuation of uses, we asked respondents to name the five human uses or activities (current or potential) they consider most important to prioritize in a hypothetical MU-CMPA. In the last dimension, valuation of threats, respondents were presented with a list of human activities and natural events; they were then asked to evaluate them regarding the level of threat (7-point intensity scale from 1, very low, to 7, very high) that they represented to the conservation of ES and biodiversity features in the area. We also invited respondents to add ES or threats to the initial lists.

Section Three: Expectations for the possible establishment of a MU-CMPA. We used five Likert scale statements (5-point scale ranging from strongly disagree to strongly agree) to evaluate stakeholders' expectations regarding a MU-CMPA and its potentiality as a tool to protect biodiversity and fisheries resources, to maintain artisanal fisheries, and to foster

[15] Based on goods and ecosystem services previously identified in the area by Vásquez et al. (2010), and complemented and validated by five key informants (three researchers, one fishermen representative, and one government agency representative).

sustainable uses in the area as well as stakeholders' perceptions regarding current management and conservation in the study area.

Table 5.2. Ecosystem goods and services identified in the study area. Categorization based on de Groot et al. (2002) and Beaumont et al. (2007).

Ecosystem good and service	Description	Category
Habitat for charismatic species	Area where species such as bottlenose dolphins, Humboldt penguins, sea otters, and sea lions, among others, live, feed, and breed	Supporting
Habitat for migratory species	Transit and feeding area for migratory species such as whales and seabirds	Supporting
Kelp habitat	Kelp provides the physical structure for diverse subtidal communities including commercial species	Supporting
Spawning and nursery grounds	Area where high densities of larvae and recruitment of commercial marine species occur	Supporting
Fishing grounds	Highly productive area in terms of commercial fish and shellfish abundance	Provisioning
Seafood	Fish and shellfish are consumed as food by human local communities	Provisioning
Aquaculture	Good area for aquaculture production	Provisioning
Environmental education	Area where activities and programs of environmental education can be developed	Cultural
Wildlife watching	Area with good conditions for permanent or seasonal wildlife watching	Cultural
Research	Interesting area for the development of scientific research	Cultural
Tourism	Good area for developing tourism activities such as camping, gastronomy, cabin complexes, boating, hiking, and the recreational use of beaches, among others	Cultural
Diving areas	Good area for developing recreational diving	Cultural
Landscape value	Area of great landscape value for coastal residential development	Cultural

5.3.3. Data analysis

Perceptions regarding the presence and importance of ES, the importance of threats, and expectations regarding a potential MU-CMPA were evaluated considering two factors: category of stakeholder (i.e., eight stakeholder groups) and type of user (i.e., direct or indirect). Differences among groups were tested with a non-parametric Kruskal–Wallis test followed by a post hoc Dunn's test to determine which groups were different. Differences between types of users were tested with a non-parametric Mann-Whitney U test. These statistical analyses were carried out in the R environment version 2.15.2 (R Core Development Team 2012).

To investigate how the prioritization of ES, biodiversity features and uses varied among groups defined by category of stakeholder and type of user, we performed non-parametric multivariate analysis using the statistical software PRIMER 6.0 (Clarke & Warwick 2001). From presence/absence data, similarity matrices were constructed for ES, biodiversity features and uses using the Bray–Curtis index of similarity (Bray & Curtis 1957). A one-way analysis of similarity randomized permutation test (ANOSIM) was used to investigate whether significant differences existed among the different groups defined by factors (Clarke and Warwick 2001). Ordination plots were created using non-metric multi-dimensional scaling (nMDS) to allow visual comparison of the similarity relationships among stakeholders' responses. Subsequently, a similarity percentages routine (SIMPER) was used to identify the variables that contributed most to dissimilarities that occurred among groups defined by factors. Finally, a simple relational analysis of prioritized ES, biodiversity features and uses was made using a conceptual network map. A symmetrical matrix with the top 5 ES,

biodiversity features and uses was arranged and a qualitative dependency relationship value (a score of 0 indicating no dependency relationship, 1 a weak or indirect relationship, and 2 a strong or direct relationship) between two individual components was assigned (e.g., dependency of ecotourism on seabirds or marine mammals, of artisanal fishing on fishing grounds) based on literature review of ES and validated by key informants (see note 15). To assess the network connection, network analyses were performed using UCINET 6.0 software and graph visualizations were created using NETDRAW 2.0 (Borgatti et al. 2002). We calculated the network density (the proportion of all possible links present in a network) and betweenness centralization (the variation in the number of times that components in the network lie on paths between other components) (Hanneman & Riddle, 2005) as well as betweenness centrality for each individual component, obtaining a measure of the potential control or influence that a component has over the flow in the network (Prell 2012).

5.4. Results

5.4.1. Valuation of ES and threats

Stakeholder's perceptions regarding the presence of ES are shown in Table 5.3. Of thirteen ES, twelve achieved scores from moderately present to highly present (scores 3 to 5), and only aquaculture scored as slightly present. Differences among categories of stakeholders were found only for landscape value ($H= 20.84$, $P < 0.01$), the valuation by National Government Agencies (2.6) being significantly lower than that by Land Owners (4.0), Regional Government Agencies (4.0) and University or Research Institutes (3.8) (post hoc Dunn's test).

No significant differences were detected between direct and indirect users (Mann-Whitney U test, P > 0.05) (Table 5.3).

Table 5.3. Stakeholders' perceptions regarding the presence of ecosystem goods and services. Values are the mean of all stakeholders ± standard error (SE). A Kruskal-Wallis test (H) with post hoc Dunn's test was used to calculate differences among stakeholder categories (see below table). A Mann-Whitney U test (Z) was used to calculate differences between direct and indirect users. Values in parentheses correspond to the mean values of different stakeholder groups.

Ecosystem good or service	Mean ± SE	H value	Z value
Spawning and nursery grounds	4.4 ± 0.10	7.00	1.37
Fishing grounds	4.4 ± 0.11	7.49	0.77
Wildlife watching	4.2 ± 0.11	10.43	1.21
Habitat for charismatic species	4.1 ± 0.14	8.78	0.44
Kelp habitat	4.1 ± 0.10	10.19	0.13
Tourism	4.1 ± 0.11	2.77	0.12
Diving areas	4.1 ± 0.11	4.22	0.15
Habitat for migratory species	4.0 ± 0.13	6.18	0.20
Research	4.0 ± 0.12	3.84	-0.53
Seafood	3.7 ± 0.13	5.86	0.35
Environmental education	3.6 ± 0.16	9.39	-0.76
Landscape value	3.2 ± 0.11	20.84**[A]	-0.60
Aquaculture	2.5 ± 0.15	4.41	-0.47

[A] NAG (2.6) < LAND (4.0) = REG (4.0) = RES (3.8)
** P< 0.01
Scores from 1 to 5, where 1 is not at all present and 5 is highly present
NAG= National Government Agencies, LAND= Land Owners, REG= Regional Government Agencies, RES= Universitiesor Research Institutes

Stakeholder`s perceptions regarding the importance of ES are shown in Table 5.4. For the overall mean score, of thirteen ES, eleven achieved scores from very important to extremely important (scores 4 to 5) and only 2 were scored moderately important (scores close to 3). Differences among categories of stakeholders were found for wildlife watching (Kruskal-Wallis test, H= 19.13, P < 0.01) and tourism (H= 13.03, P < 0.05), Artisanal Fishermen

Organizations being the group that assigned the lowest scores of all groups (post hoc Dunn's test). Differences between direct and indirect users were found for habitat for charismatic species (Mann-Whitney U test, Z= 2.21, P < 0.05), wildlife watching (Z= 2.03, P < 0.05), and spawning and nursery grounds (Z= 2.05, P < 0.05). For three ES, direct users' valuations were lower than indirect users, but all scores ranged between very important and extremely important (Table 5.4).

Table 5.4. Stakeholder`s perceptions regarding the importance of ecosystem goods and services. Values are the mean of all stakeholders ± standard error (SE). A Kruskal-Wallis test (H) with post hoc Dunn's test was used to calculate the differences among stakeholder categories (see below table). A Mann-Whitney U test (Z) was used to calculate the differences between direct and indirect users. The values in parentheses correspond to the mean values of different stakeholder groups.

Ecosystem good or service	Mean ± SE	H value	Z value
Habitat for charismatic species	4.8 ± 0.07	14.43	2.21*[C]
Fishing grounds	4.8 ± 0.07	10.42	1.06
Environmental education	4.7 ± 0.08	6.00	-0.06
Habitat for migratory species	4.6 ± 0.10	14.33	1.39
Wildlife watching	4.6 ± 0.10	19.13**[A]	2.03*[D]
Research	4.5 ± 0.10	11.94	1.37
Kelp habitat	4.5 ± 0.09	13.59	1.41
Spawning and nursery grounds	4.4 ± 0.10	9.68	2.05*[E]
Tourism	4.3 ± 0.09	13.03*[B]	1.54
Diving areas	4.3 ± 0.07	9.35	0.91
Seafood	4.0 ± 0.11	9.84	-0.72
Landscape value	3.5 ± 0.13	10.50	-0.06
Aquaculture	3.3 ± 0.15	11.14	-1.68

[A] AFOR (3.9) < NGO (5.0) =TOUR (5.0) = NAG (4.9)
[B] AFOR (3.9) < LAND (5.0) = NGO (4.8)
[C] DIR (4.5) < IND (4.8)
[D] DIR (4.1) < IND (4.6)
[E] DIR (4.3) < IND (4.7)
**P< 0.01 *P< 0.05
Scores from 1 to 5, where 1 is not at all important and 5 is extremely important
AFOR= Artisanal Fishermen Organizations, NGO= Environmental NGOs, TOUR= Tourism Enterprises, NAG= National Government Agencies, LAND= Land Owners, DIR= Direct users, IND= Indirect Users

Stakeholders' perceptions regarding the threat levels posed by different activities or events are shown in Table 5.5. Of twenty-two threats, eleven achieved high scores (scores of 5 to 7), eight medium scores (3 to 5), and three low threat scores (1 to 3). Power plants, industrial fishing, illegal fishing, and mining were considered the main threats in the area. On the other hand, recreational fishing, scientific research, and protected areas were considered the activities with the lowest threat levels. Differences among categories of stakeholders were found for illegal fishing ($H= 20.61$, $P < 0.01$), ports ($H= 14.46$, $P < 0.05$), artisanal fishing ($H= 18.95$, $P < 0.01$), and agriculture ($H= 22.53$, $P < 0.01$). Significant differences between direct and indirect users were detected for illegal fishing ($Z= -2.49$, $P < 0.05$), artisanal fishing ($Z= 2.49$, $P < 0.05$), and agriculture ($Z= 3.42$, $P < 0.01$) (Table 5.5).

5.4.2. Prioritization of ES, biodiversity features and uses

Habitat for charismatic species was the highest-prioritized ES by stakeholders (83% of respondents), followed by fishing grounds (64%), kelp habitat, habitat for migratory species and wildlife watching (values close to 50%) (Fig. 5.2). Significant differences in the prioritization of ES were only found when considering the stakeholder category as a factor (ANOSIM, Global $R = 0.172$, $P < 0.01$). Differences among groups were found for dissimilarities in prioritizations between Artisanal Fishermen Organizations and four other groups (Table 5.6). The latter is visually corroborated by an nMDS scaling plot (Fig. 5.3). The SIMPER analysis indicated that habitat for migratory species, habitat for charismatic species and wildlife watching were the most important ES contributing to the dissimilarity among groups (SIMPER analysis in Annex 5.1).

Table 5.5. Stakeholders' perceptions regarding the threat levels posed by different activities or events. Values are the mean of all stakeholders ± standard error (SE). A Kruskal-Wallis test (H) with post hoc Dunn's test was used to calculate differences among stakeholders' categories (see below table). A Mann-Whitney U test (Z) was used to calculate differences between direct and indirect users. Values in parentheses correspond to the mean values of different stakeholder groups.

Threat	Mean ± SE	H value	Z value
Power plants	6.1 ± 0.24	11.74	0.38
Industrial fishing	6.1 ± 0.19	11.82	-1.45
Illegal fishing	6.0 ± 0.16	20.61**[A]	-2.49*[E]
Mining	6.0 ± 0.22	12.31	1.42
Invasive species	5.8 ± 0.18	8.72	0.68
Marine Pollution	5.8 ± 0.19	7.18	0.36
Dumps	5.5 ± 0.23	12.64	-0.87
Climate change	5.4 ± 0.20	6.82	1.22
Kelp harvesting	5.3 ± 0.21	11.37	0.65
Coastal residential development	5.2 ± 0.20	6.82	0.39
Ports	5.0 ± 0.24	14.46*[B]	1.30
ENSO events	4.6 ± 0.23	8.72	-0.70
Maritime traffic	4.3 ± 0.22	5.67	0.16
Coastal erosion	4.1 ± 0.20	10.02	1.54
Development tourism facilities	4.1 ± 0.20	4.91	1.00
Ecotourism	3.7 ± 0.23	9.07	1.84
Artisanal fishing	3.6 ± 0.25	18.95**[C]	2.49*[F]
Agriculture	3.4 ± 0.27	22.53**[D]	3.42**[G]
Aquaculture	3.3 ± 0.24	7.51	1.96
Recreational fishing	2.8 ± 0.18	4.19	1.15
Scientific research	1.5 ± 0.12	3.91	0.28
Protected areas	1.4 ± 0.12	4.73	-1.85

[A] NAG (5.2) < NGO (7.0)
[B] AFOR (3.5) < NGO (6.0)
[C] AFOR (1.7) < RES (4.6) = NAG (4.2)
[D] AFOR (1.9) < NAG (4.2)
[E] IND (5.7) < DIR (6.5)
[F] DIR (2.8) < IND (4.0)
[G] DIR (2.3) < IND (4.0)
Scores of threat level from 1 to 7, where 1 is very low and 7 is very high.
NAG= National Government Agencies, NGO= Environmental NGOs, AFOR= Artisanal Fishermen Organizations, RES= Universities or Research Institutes, DIR= Direct users, IND= Indirect Users
* P< 0.05 **P< 0.01

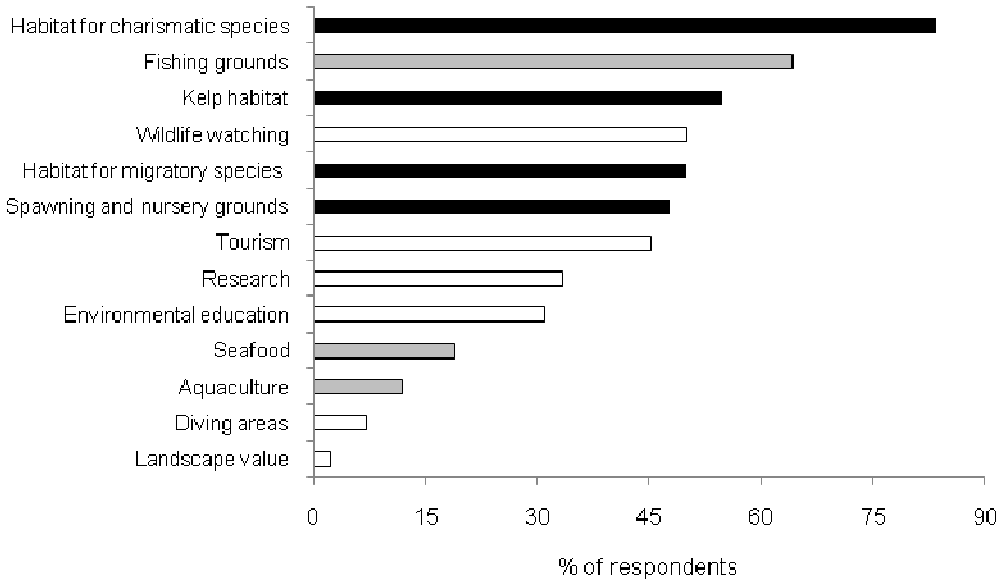

Fig. 5.2. Ecosystem goods and services prioritized by stakeholders. Black bars indicate supporting services, gray bars provisioning services, and white bars cultural services.

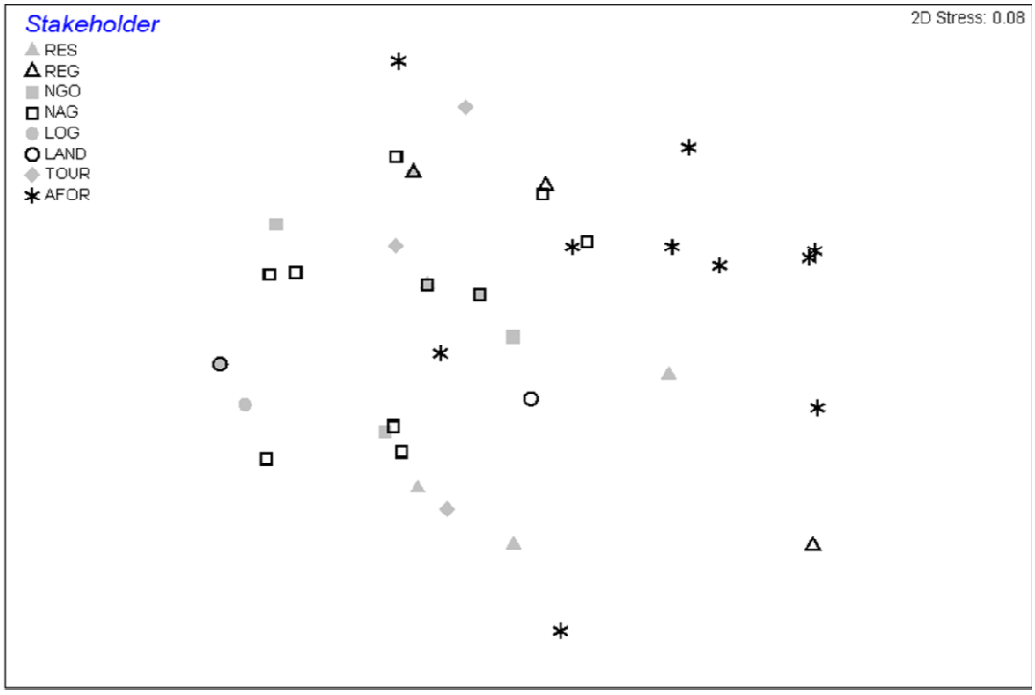

Fig. 5.3. Non-metric MDS ordination plot of the similarity of stakeholders' responses for prioritization of ecosystem goods and services. Stakeholders with relatively similar prioritizations are positioned closer to each other. RES= Universities or Research Institutes, REG= Regional Government Agencies, NGO= Environmental NGOs, NAG= National Government Agencies, LOG= Local Governments, LAND= Land Owners, TOUR= Tourism Enterprises, AFOR= Artisanal Fishermen Organizations.

Respondents mentioned 28 biodiversity features (Fig. 5.4). Kelp, the island system and endemic flora were the most prioritized biodiversity features (55, 40, and 38 % of respondents, respectively), followed by fisheries resources, dolphins, seabirds, and marine mammals (31 %). Significant differences in the prioritization of biodiversity features were found when considering stakeholder category (ANOSIM, Global R = 0.362, P < 0.01) and user type (ANOSIM, Global R = 0.133, P < 0.01). Differences among groups were principally represented by dissimilarities in prioritizations between Artisanal Fishermen Organizations and all other groups (Table 5.6 and nMDS scaling plot in Fig. 5.5). The highly valued gastropod *Concholepas concholepas,* hereafter *loco*, and fisheries resources were the most important biodiversity features contributing to the dissimilarity among groups, followed by endemic flora, dolphins and marine mammals (SIMPER analysis in Annex 5.1). On the other hand, *loco*, kelp, and the island system were the most important biodiversity features contributing to the dissimilarity between direct and indirect users (SIMPER analysis in Annex 5.2).

Respondents recognized 20 existing and potential uses and activities for the study area (Fig. 5.6). Artisanal fishing, scientific research and marine reserve were considered the priority uses or activities in a MU-CMPA (71, 69, and 62 % of respondents, respectively), followed by environmental education, ecotourism and wildlife watching (55 and 50 %, respectively). Significant differences in the prioritization of uses and activities were found considering only stakeholder category as a factor (ANOSIM, Global R = 0.158, P < 0.05). Differences among groups consisted of dissimilarities in prioritizations between Artisanal Fishermen Organizations and four other groups (Table 6 and nMDS scaling plot in Fig. 5.7). Scientific research, restocking/habitat restoration, terrestrial reserves, and MEABRs were the most

important uses and activities contributing to the dissimilarity among groups (SIMPER analysis in Annex 5.1).

Table 5.6. ANOSIM results from comparing stakeholders' prioritizations of ecosystem services, biodiversity features, and uses and activities in the study area.

			Pairwise tests, N groups > 2	
	Groups according	Global R	Different groups	R
Ecosystem goods and services	Stakeholder categories	0.172**	NGO, AFOR	0.541**
			NAG, AFOR	0.375**
			LOG, AFOR	0.428*
			LAND, AFOR	0.439*
	User type	0.078		
Biodiversity features	Stakeholder categories	0.362**	RES, AFOR	0.76**
			REG, AFOR	0.619**
			NGO, AFOR	0.760**
			NAG, TOUR	0.272*
			NAG, AFOR	0.503**
			LOG, AFOR	0.850*
			LAND, AFOR	0.687*
			TOUR, AFOR	0.814**
	User type	0.133**		
Uses and activities	Stakeholder categories	0.158*	RES, AFOR	0.311*
			NGO, AFOR	0.325*
			NAG, LOG	0.525*
			NAG, AFOR	0.426**
			LAND, AFOR	0.323*
	User type	0.088		

* P< 0.05 **P< 0.01
AFOR= Artisanal Fishermen Organizations, NGO= Environmental NGOs, NAG= National Government Agencies, LOG= Local Governments, RES= Universities or Research Institutes, REG= Regional Government Agencies, LAND= Land Owners, TOUR= Tourism Enterprises

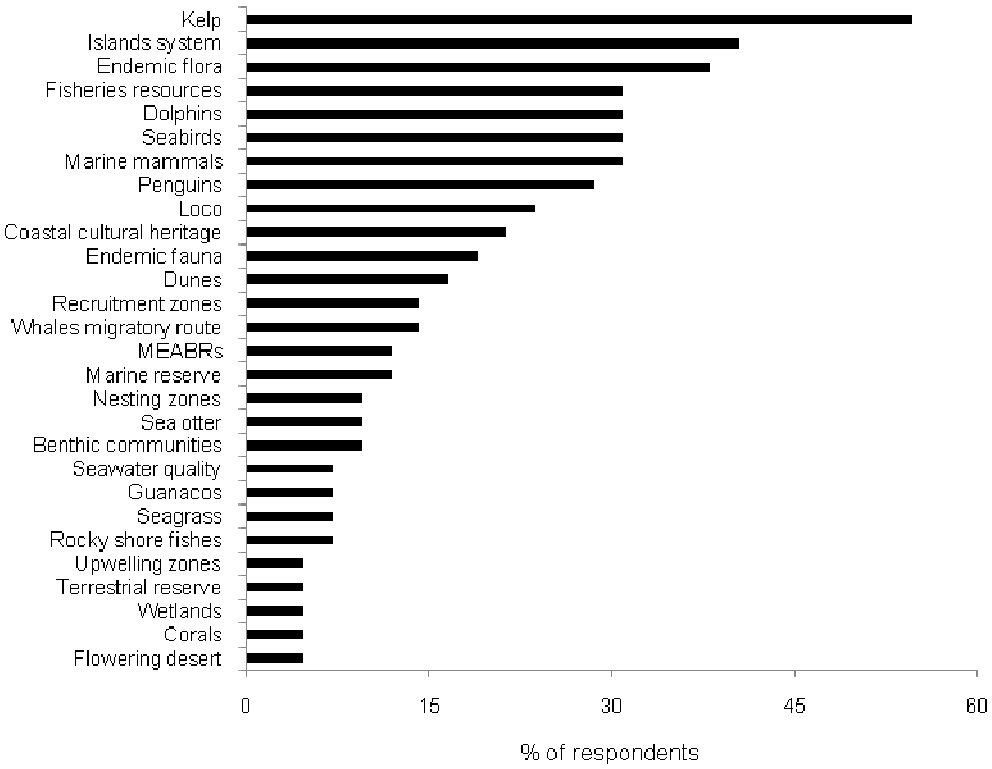

Fig. 5.4. Biodiversity features prioritized by stakeholders.

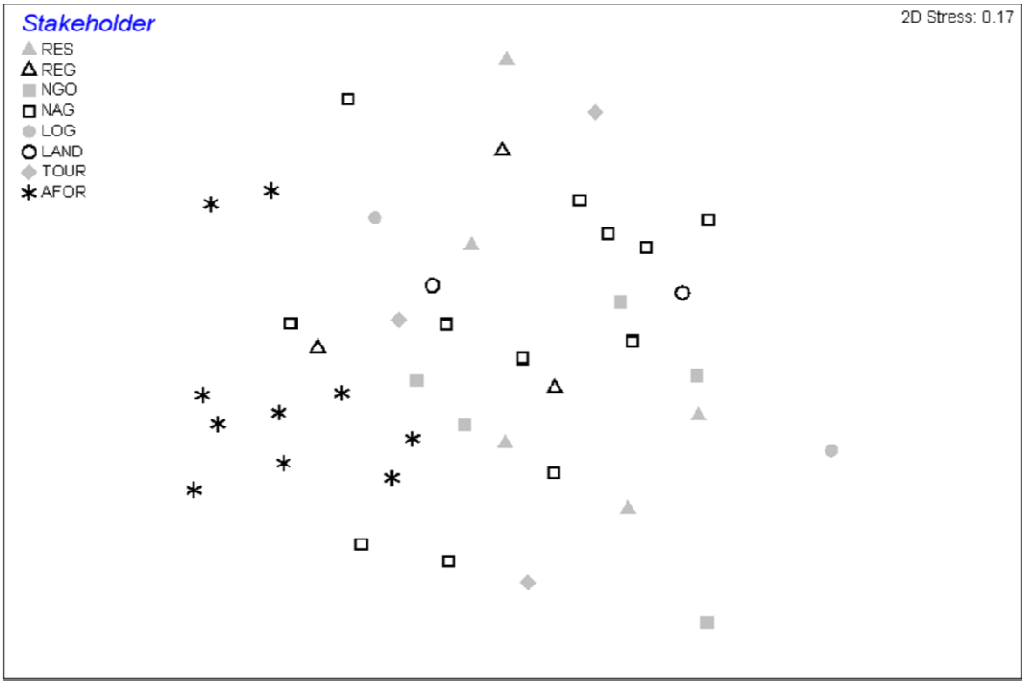

Fig. 5.5. Non-metric MDS ordination plot of the similarity of stakeholders' responses for prioritization of biodiversity features. Stakeholders with relatively similar prioritizations are positioned closer to each other.

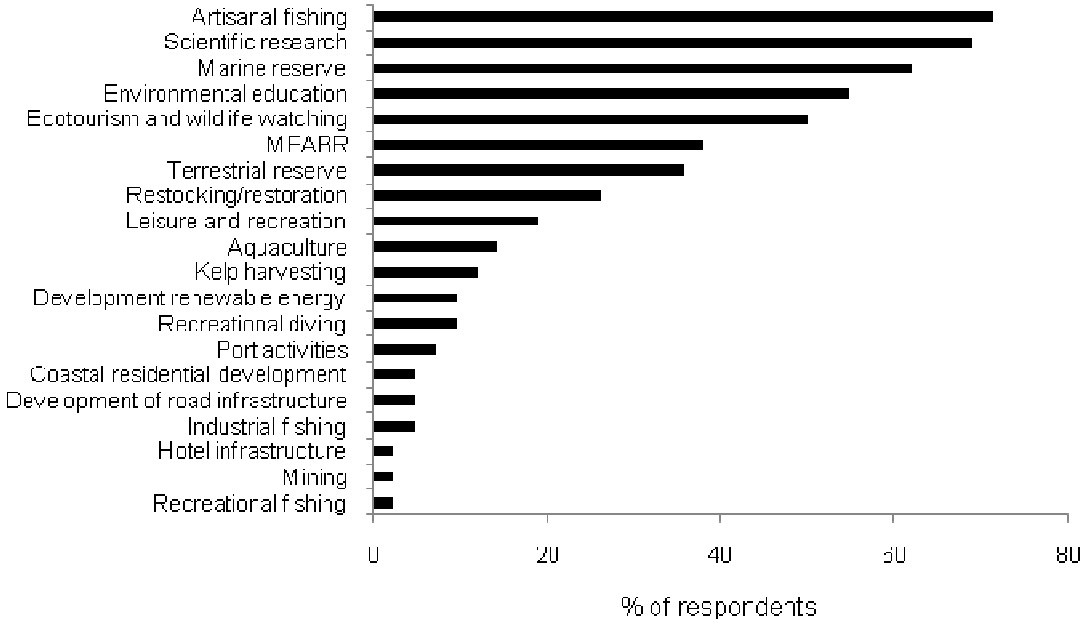

Fig. 5.6. Uses and activities prioritized by stakeholders for a hypothetical MU-CMPA.

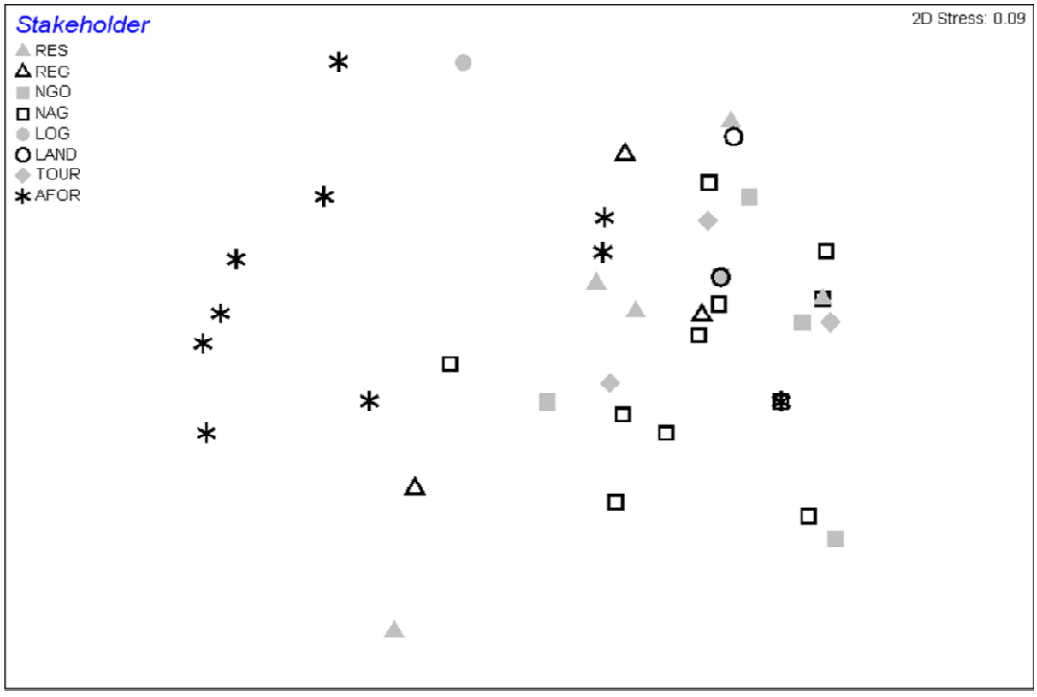

Fig. 5.7. Non-metric MDS ordination plot of similarity of stakeholders' responses for the prioritization of uses and activities for a hypothetical MU-CMPA. Stakeholders with relatively similar prioritizations are positioned closer to each other.

5.4.3. Expectations for a new MU-CMPA

Most stakeholders agreed on the potentiality of a MU-CMPA as a tool to protect biodiversity (74 %), fisheries resources (62 %), and artisanal fisheries (64 %) and to foster sustainable uses of the area (91 %) (Table 5.7). Perceptions of the management and conservation actions that have been implemented to date in the study area were negatively evaluated by 50 % of respondents, who indicated that they disagree or strongly disagree with the actions. A positive perception was reported by only 21 % of respondents (Table 5.7). There were no significant differences in expectations or perceptions among the groups according to stakeholder category (Kruskal-Wallis test, $P > 0.05$) or user type (Mann-Whitney U test, $P > 0.05$).

Table 5.7. Overall mean of responses and percentage of total statements related to stakeholders' expectations of MU-CMPA performance and stakeholders' perceptions of current management and conservation in the study area.

		Likert scale, Percentage of total				
Statement	Mean ± SE	1	2	3	4	5
The MU-CMPA is a good option for protecting biodiversity in the study area	4.0 ± 0.14	0	7	19	38	36
The MU-CMPA is a good option for protecting fisheries resources in the study area	3.8 ± 0.14	0	7	31	38	24
The MU-CMPA is a good option for protecting artisanal fisheries in the study area	3.8 ± 0.12	0	3	33	45	19
The MU-CMPA is a good option for fostering new and sustainable uses or activities in the study area	4.4 ± 0.11	0	2	7	36	55
To date, appropriate management and conservation actions have been implemented in the study area	2.7 ± 0.13	5	45	29	21	0

Likert scale, 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree

5.4.4. Relational analysis between prioritizations

The network of ES, biodiversity features and uses was well connected, with a very high density value (72 %) and a low centralization value (2.99 %), indicating that the prioritized components by stakeholders were highly related and dependent between them (Fig. 5.8).

The uses of marine reserve, ecotourism and artisanal fishing (10.1, 8.3, and 5.7, respectively) and the ES of habitat for charismatic species and wildlife watching (9.4 and 7.9, respectively) achieved the highest betweenness centrality values (i.e., they represented more connections between two other prioritizations that were themselves disconnected) (Fig. 5.8, Annex 5.3), indicating their potential greater influence or dependency that these components have over the entire network.

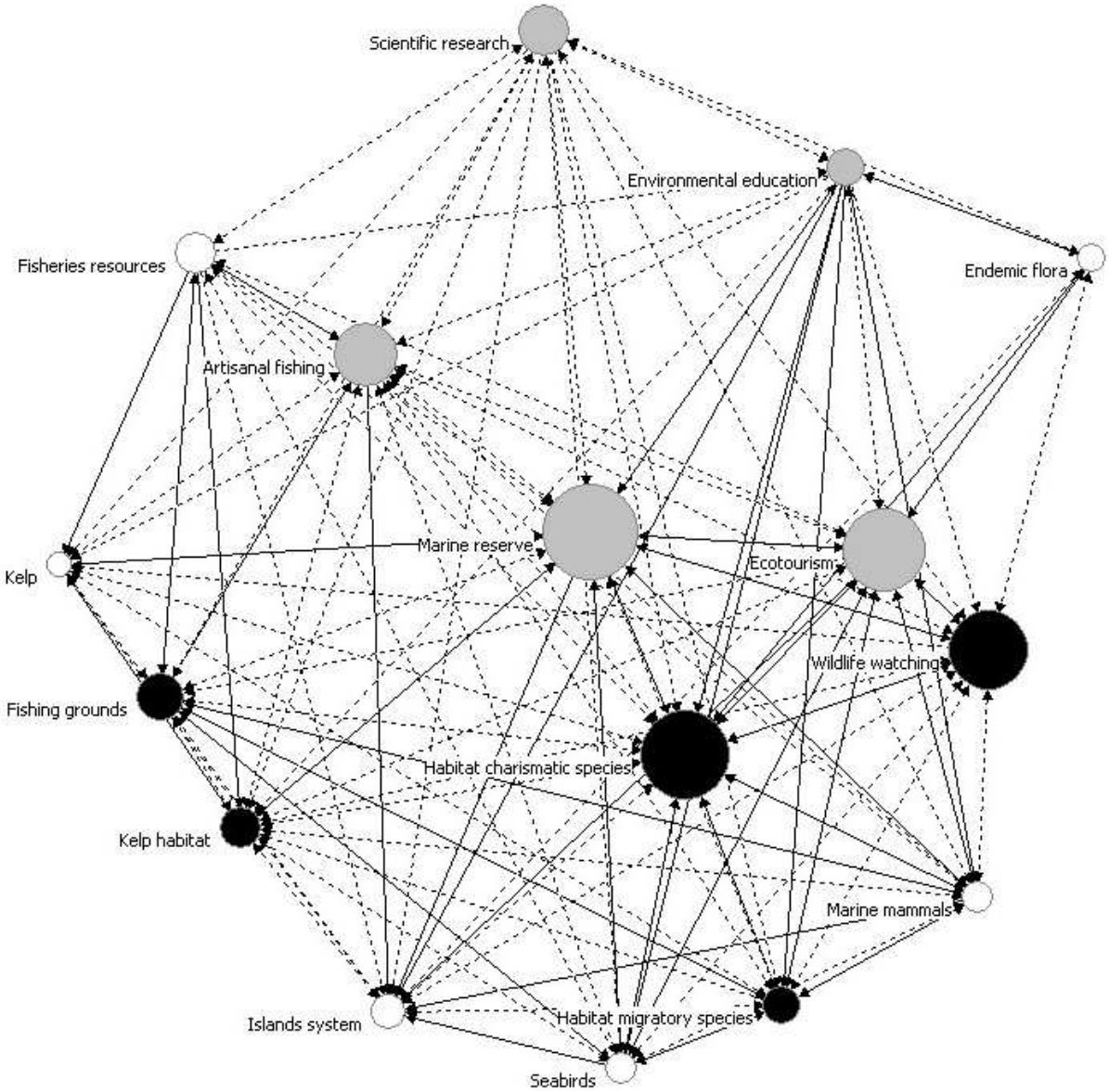

Fig. 5.8. Conceptual network representing dependency relationships among ES, biodiversity features and uses prioritized by stakeholders. Graph based on multidimensional scaling (MDS) ordination. Arrows indicate the directionality of relationships. Weak or indirect relationships are represented by dotted lines and strong or direct relationships are represented by solid lines. Black circle: ecosystem good or service; white circle: biodiversity feature; and grey circle: use or activity. The size of each node positively correlates with the betweenness centrality value for each component (larger node indicates higher betweenness).

5.5. Discussion

5.5.1. Valuation of ES and threats

Environmental valuation (e.g., biological diversity valuation) is related to the cultural values constructed from a given perspective in time and space, wherein the intensity of environmental valuation is highest in the here and now (Norton & Hannon 1997). In our study, most ES were highly valued by all stakeholders in terms of both presence and importance. The most highly scored ES were the natural conditions of this area for biodiversity, fisheries and wildlife watching (i.e., habitat for charismatic and migratory species, fishing and nursery grounds), confirming those described in the scientific literature (Thiel et al. 2007, Luna-Jorquera et al. 2012, Cárcamo & Gaymer in press). Very few significant differences among groups (considering stakeholder category or user type) were observed for valuation of ES and threats. Artisanal fishermen exhibited the most significant differences with respect to other groups. Wildlife watching and tourism were the ES scored lowest by fishermen, most likely because only a few organizations in this area have ventured into ecotourism, whereas their livelihoods are almost exclusively dependent on fishing. Heterogeneity in the attitudes and perceptions towards MPA-related topics among fishermen have been explained according to livelihoods and/or personal interests (Gelcich et al. 2005, Mangi & Austen 2008, Pita et al. 2013).

The most threatening activities identified by the respondents were power plant operation, mining, and industrial and illegal fishing. Kasperson et al. (1988) argue that public responses to risk perception can be amplified or attenuated by psychological, social, and cultural processes. Negative perceptions of power plants can be explained by the social conflict arising in response to the intentions of the Chilean government and private interests to build three

coal-fired power plants along the coastline of our study area. The projects face great opposition from different sectors of society, including fishermen (Cárcamo et al. 2011). Potential conflicts are currently foreseen with the building of mining ports planned for the same coastline.

Industrial and illegal fishing were principally associated with dynamite and trawling fishing (stakeholders' commentaries during application of questionnaires). Despite dynamite fishing being legally prohibited in Chile, it is closely associated with recent massive seabird and sea lion mortalities in the study area (Cárcamo & Gaymer in press). The high valuation that stakeholders assigned to most ES in the area may influence the perception and valuation of threats (Brown et al. 2002). Differences among groups were explained principally by the lower threat scores assigned by fishermen to activities closely related with their livelihoods, such as artisanal fishing and port activity.

5.5.2. Relational analysis between prioritizations

Differences among groups were principally represented by dissimilarities in fishermen's prioritizations with respect to other groups. Habitat for charismatic and migratory species and wildlife watching were the most important ES contributing to this dissimilarity. A hypothesis on the spatial relevance regarding stakeholders' perceptions notes that people living in proximity to a natural resource (e.g., fishermen) tend to favor its economic use, whereas those living at a greater distance tend to favor resource conservation (Newig & Fritsch 2009). The latter was also corroborated when prioritization for biodiversity features and uses were analyzed. *Loco*, the primary resource exploited in existing MEABRs, which is co-managed by

artisanal fishermen (Aburto et al. 2009), was strongly prioritized by fishermen together with kelp and fisheries resources. Conversely, endemic flora, dolphins, and marine mammals were not prioritized by fishermen or direct users. A similar trend was observed for priority uses or activities for a hypothetical MU-CMPA, where MEABRs and restocking/habitat restoration (activity suggested in some cases to improve the yield of MEABRs) were prioritized by fishermen as opposed to scientific research and terrestrial reserves.

When we related prioritized ES, biodiversity features and uses within a conceptual network, we found a highly cohesive system indicating the connectedness among components (Prell 2012). The use of conceptual models based on network graphs, as used in this study, may provide a common ground for sharing knowledge and information between scientists, managers, and users. Conceptual maps have been used as a planning and evaluation tool for reducing environmental complexity (Delgado et al. 2009). We recommend their use to allow the stakeholders and general public to observe the dependency relationships (e.g., synergies) and possible trade-offs among different ES (e.g., habitat for charismatic species), biodiversity features (e.g., marine mammals), and uses (e.g., ecotourism, artisanal fishing) that occur in this particular social-ecological system. Also, this condensed version of the entire network of environmental components identified in this study should be used to support a public process to discuss and define a common vision of the future of the MU-CMPA (e.g., the main conservation goals).

5.5.3. Expectations for a new MU-CMPA

Consensus was achieved for all categories of stakeholders with respect to the suitability of a hypothetical MU-CMPA, hence indicating high expectations of its benefits. These expectations can be useful for designing MPA performance indicators and as guides for management actions (Heck & Dearden 2012). Perceived ecological and economic benefits have been identified as significant predictors of MPA public support (Thomassin et al. 2010, Hoelting et al. 2013). MPA implementation affects a heterogeneous community of stakeholders, although generally fishermen are the most negatively or positively affected by management decisions (e.g., no-take zones, restrictions of gear, improvement in fisheries yields derived from protection) (Oracion et al. 2005, Mascia et al. 2010, Lopes et al. 2013, Rees et al. 2013). Thus, it is expected that fishermen negatively affected by management actions will show low support for MPAs (Mangi & Austen 2008, Hoelting et al. 2013) or perceive MPAs and their effectiveness in different ways (Pita et al. 2013). In our study, this pattern was not observed, possibly due to some surveyed fishermen living and working in proximity to existing marine reserves in the area where they have ventured into ecotourism and wildlife watching. Consequently, they may have a positive perception of MPAs (Cárcamo & Gaymer in press). However, definitive support for a new MU-CMPA will likely depend on whether fishermen's perceptions and goals are considered and incorporated into the planning process (Oracion et al. 2005, Gelcich et al. 2009b, Lopes et al. 2013).

5.5.4. Value and applicability of including stakeholders' perceptions

Multiple-Use Coastal Marine Protected Areas have been recognized as a tool for managing large and diverse marine ecosystems (Mangi & Austen 2008) and an opportunity to implement EBM in Chile (Cárcamo et al. 2013). However, overlapping stakeholder interests under some circumstances and confusion regarding MPA goals may create problems rather than generating solutions (Oracion et al. 2005, Mangi & Austen 2008). In our study area, the hypothetical declaration and subsequent implementation of a MU-CMPA will occur in areas where several human uses and local management measures already exist. In this case, an important first step is to consider the existing conditions (e.g., uses, management measures, legal framework) and move towards an agreement on the common goals among different stakeholders, identifying areas of conflict. It has been proven that engaging different stakeholders and incorporating perceptions and opinions in all stages of the science-policy process for implementing a MPA enhances agreements likelihood and improves social acceptability, legitimacy and support for future MPAs (Thomassin et al. 2010, Hoelting et al. 2013). At the same time, it provides insight into local issues that need to be addressed by a new MPA (Charles & Wilson 2009, Lopes et al. 2013) and permits decision makers to anticipate and resolve conflicts integrating different perspectives into the decision-making process (Ressurreição et al. 2012).

To advance the definition of goals and targets for planning the new MU-CMPA considering stakeholders' input, we propose to use a framework including trade-offs between biodiversity and ecosystem services and the relationships with existing and potential uses and threats to biodiversity and ES provision. A common ground that incorporates biodiversity (intrinsic

values) and ES (instrumental values) has been acknowledged as a useful framework to address environmental degradation and biodiversity loss (Reyers et al. 2012). However, a major challenge for implementing proposed Chilean MU-CMPAs will be to improve the coordinated work among different national and regional government agencies (Cárcamo et al. in review). Considering the particular features of a MU-CMPA as to its uses and objectives (e.g., biodiversity conservation, fishing, low-impact commercial and recreational activities), administration (i.e., public-private including regional governments and NGOs), the potential to develop an EBM, and the complexity of the Chilean seascape (i.e., coasts with many aquaculture concessions and MEABRs), we suggest initiating a public process of analyzing and allocating the spatial and temporal distribution of human uses and activities in the area of MU-CMPAs, a process known as Marine Spatial Planning (MSP) that aims to achieve ecological, economic, and social goals defined through a participative political process (Ehler & Douvere 2007). This process has been proposed as a solution to overcome some shortfalls of MPAs (Agardy et al. 2011). In some cases, multiple-use MPAs can be considered outcomes of the MSP process (Ban et al. 2012). Our findings on stakeholders' perceptions and prioritizations regarding diverse ES, biodiversity features and uses should be used as a basis to define a common vision and to start a MSP process for the MU-CMPA. Indeed, the first stage of the MSP is based on multiple instances of research that incorporate human and environmental processes (Crowder & Norse 2008, St. Martin & Hall-Arber 2008), the main outputs being comprehensive spatial plans that correspond to a vision of the future of the region or ecosystem that should reflect goals and targets defined by stakeholders and decision makers (Douvere 2008, Collie et al. 2013).

Finally, early engagement of stakeholders will be key to understanding the variability in environmental perceptions and reflecting that in planning and management actions for the MU-CMPA, improving support for its implementation and achieving conservation and societal goals.

Capítulo 6. Avanzando hacia un manejo basado en ecosistemas. Elementos claves para una estrategia de planificación

6.1. Introducción

Las áreas marinas protegidas (AMPs) bien manejadas han sido reconocidas como efectivas para proteger los ecosistemas marinos y costeros, sin embargo, su funcionamiento aislado no es suficiente para asegurar la conservación de la biodiversidad y la sustentabilidad de áreas o ecosistemas en una escala espacial amplia (situación analizada en el Capítulo 2 de esta tesis). Las AMPs generalmente no se ocupan de la multiplicidad de usos, intereses y presiones humanas que existen en las áreas costeras. De ahí que se necesiten otras opciones de manejo para satisfacer las necesidades sectoriales actuales y futuras. En la actualidad, las AMPs son concebidas como un componente esencial del manejo basado en ecosistemas (MBE), siendo incorporadas, por ejemplo, a través de la generación de un plan de manejo espacialmente explícito o una zonificación (Ruckelshaus et al. 2008, Agardy 2010). Numerosas iniciativas de MBE se han visto obstaculizadas, principalmente, por factores como: falta de marco legal de soporte y de estructuras de gobernanza, complejidad de los procesos biológicos y socioeconómicos, falta de conocimientos sobre la dinámica y la capacidad de resiliencia de los ecosistemas, falta de financiamiento y falta de herramientas prácticas para su implementación (Arkema et al. 2006, McLeod & Leslie 2009, Österblom et al. 2010, Kidd et al. 2011). Como señalan Tallis et al. (2010), es tiempo de adoptar una cultura de MBE que aumente las probabilidades de un manejo efectivo, y para ello, se debe usar la mejor ciencia natural y social disponible a través de un proceso inclusivo y transparente. Como se ha descrito en el Capítulo 1 de esta tesis, la planificación espacial marina costera (PEMC) ha sido propuesta como una herramienta central para hacer operativo el MBE. Al igual que lo descrito para el MBE, no existe consenso o una manera única para desarrollar la PEMC (Gilliland & Laffoley

2008, Fletcher et al. 2013) y probablemente cada caso o región requerirá un enfoque particular (Collie et al. 2013). Para el área de estudio de esta tesis, dadas sus características ecológicas y de gobernanza, y considerando el actual marco institucional y legal para el manejo y la planificación de recursos naturales existentes en Chile, una estrategia para implementar el MBE a corto plazo lo constituye utilizar un instrumento de planificación y manejo (existente en la legislación) como el AMCP-MU (Capítulo 3). Por otro lado, la complejidad del ecosistema natural y social (y sus interacciones) (Capítulos 2) requiere que el proceso de planificación del AMCP-MU aborde el amplio rango de temas que ocurren en el área (e.g., usos, intereses, presiones, amenazas, conflictos), en un proceso similar a los descritos para la PEMC. La gran meta de la PEMC basada en ecosistemas es distribuir los usos humanos existentes en un área determinada, manteniendo el ecosistema saludable y la provisión de servicios ecosistémicos para las actuales y futuras generaciones (Ehler & Douvere 2009, Foley et al. 2010). En el caso del AMCP-MU La Higuera-Isla Chañaral, su planificación debe reconocer las metas y conflictos de los múltiples usos existentes y potenciales, pero el énfasis debe estar en la planificación y conservación de la biodiversidad, principalmente porque es una medida de protección de la biodiversidad.

Considerando que las AMCP-MUs pueden ser un instrumento potencial para implementar el MBE en Chile y que la condición de múltiples usos (Capítulo 2 y 3), múltiples actores de interés (Capítulo 4) y múltiples objetivos de conservación y manejo (Capítulo 5) de este tipo de AMP requiere de un proceso de planificación público participativo tipo PEMC, a partir de los resultados de los capítulos 2 al 5 y de la revisión de literatura mundial relevante sobre manejo y planificación, se discuten elementos y consideraciones claves para orientar el proceso de planificación e implementación del AMCP-MU bajo el enfoque del MBE.

6.2. Gobernanza y manejo para un AMCP-MU resiliente

La futura AMCP-MU dentro de sus límites contendrá varias medidas de manejo y conservación espacialmente explícitas, como las reservas marinas, las reservas terrestres, y las AMERBs. Esta tesis exploró las interacciones de la Reserva Marina Isla Choros-Damas (Capítulo 2) bajo un marco analítico que distingue entre el sistema de gobierno y el sistema a gobernar (con un componente natural y otro social), además de las interacciones entre ambos y con el sistema socio-ecológico más amplio. Las mismas consideraciones de incrustación de medidas espaciales de manejo (*embeddedness*) deben ser consideradas para la construcción de propuestas de acciones de manejo para el AMCP-MU.

Las AMPs pueden tener diferentes mecanismos de gobernanza, desde expresiones estrictas de gobernanza de arriba hacia abajo (*top-down*) hasta AMPs que nacen y son manejadas desde la comunidad local (de abajo hacia arriba, *bottom-up*) (Oracion et al. 2005, Hind et al. 2010). En la gobernanza *top-down* destaca el papel del gobierno central y los expertos profesionales como fuentes de información, generación y vigilancia del cumplimiento de normativas, ofreciendo ventajas como el uso del poder y recursos del Estado (e.g., financieros, logísticos) y el potencial para gobernar áreas geográficas más extensas (McCay & Jones 2011). En la gobernanza *bottom-up*, la sociedad civil es empoderada mediante su participación directa, como tomadores de decisiones autónomos o como co-manejadores junto al gobierno (Castilla & Defeo 2005, Hind et al. 2010, McCay & Jones 2011). Entre estos dos enfoques pueden ocurrir y definirse variantes de gobernanza acordes a las particularidades del sistema socio-ecológico en el que está inserto el AMCP-MU. En el capítulo 4 de esta tesis, se exploraron actores de interés y redes de cooperación e intercambio de conocimiento, involucrando

agencias del gobierno central y regional, organizaciones de pescadores artesanales, ONGs, gobiernos locales, entre otros. Si bien se observó una red desconectada en términos de flujo, existe potencial para mejorarla a través de intervenciones que apunten a mejorar las redes organizacionales, para así, mejorar la gobernanza de la futura AMCP-MU y tener un mayor apoyo para las acciones y planes de manejo. Un ejemplo de intervención puede ser el fortalecimiento por parte del gobierno central o regional del trabajo de los actores de interés identificados como actores puente (e.g., ONGs, federaciones de pescadores) que permiten conectar a diferentes segmentos o grupos dentro de la red, como por ejemplo, organizaciones base de pescadores y agencias del gobierno central. La teoría de la gobernanza de recursos naturales (Kooiman et al. 2005) señala que ninguna institución en solitario puede enfrentar los desafíos de gobernanza de manera efectiva, siendo necesario el involucramiento y participación de actores de interés que representen al estado, el mercado y la sociedad civil. Cualquier arreglo de gobernanza que se construya para dar gobernabilidad al AMCP-MU debe considerar el capital social existente en el área y la tendencia global de descentralizar la toma de decisiones y el manejo de recursos naturales hacia las comunidades y gobiernos locales (Ostrom 1990, Castilla & Defeo 2005, Berkes 2007, Armitage et al. 2008).

Por su concepción de múltiples usos, el AMCP-MU estará sometida a mayores presiones y amenazas que un AMP tipo parque o reserva marina. Si sumamos esta condición, al escenario omnipresente del cambio global, tanto el manejo como la gobernanza deben orientarse hacia conferir resiliencia al sistema socio-ecológico. En un reciente análisis de AMPs alrededor del mundo, Jones et al. (2013) concluyeron que la clave para la resiliencia es la diversidad, tanto de especies en los ecosistemas naturales como de instituciones en los sistemas de gobernanza. Biggs et al. (2012) recomiendan considerar siete principios para mejorar la resiliencia de

servicios ecosistémicos (i.e., la capacidad del sistema para proporcionar servicios particulares y previamente definidos) en el contexto de perturbaciones y cambio constante de los sistemas socio-ecológicos (Fig. 6.1). Este marco considera la importancia tanto del manejo y la gobernanza para la provisión de servicios ecosistémicos, así como también, la importancia de las interacciones con el sistema socio-ecológico que lo soporta.

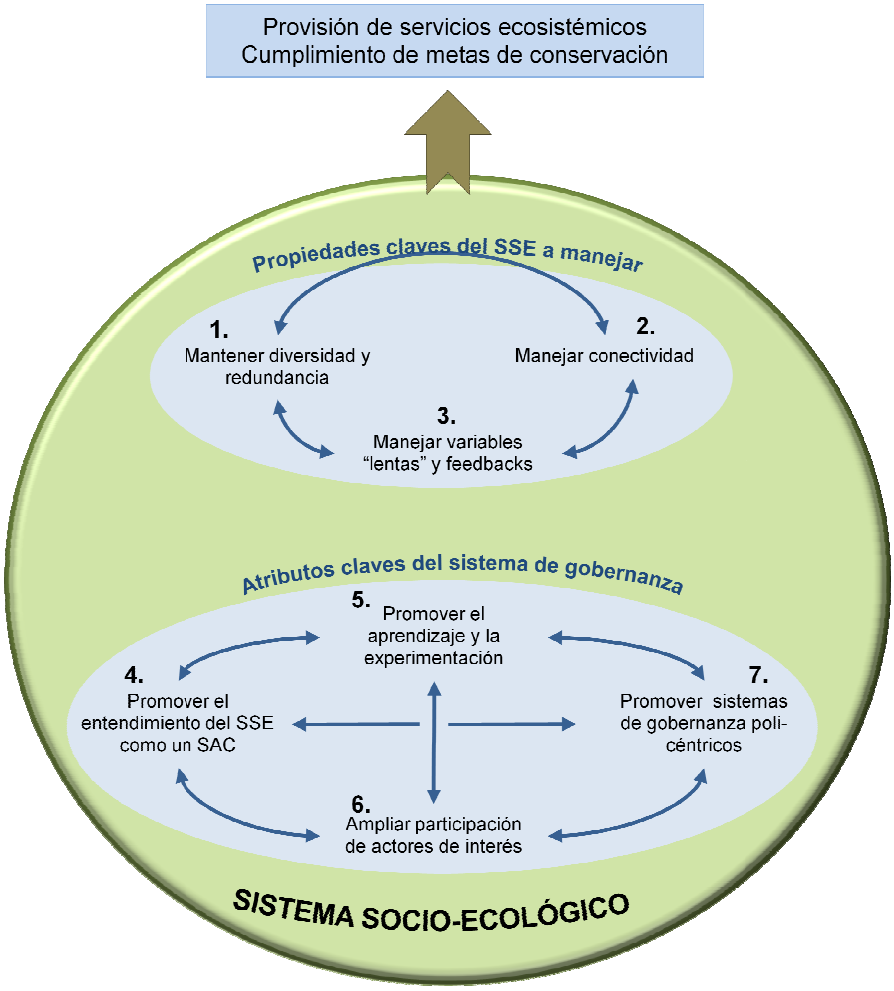

Fig. 6.1. Principios relevantes para mejorar la resiliencia de servicios ecosistémicos en sistemas socio-ecológicos (SSE) que enfrentan presiones, disturbios y constante cambio. Los principios son agrupados en aquellos que se relacionan con las propiedades del SSE que deben manejarse y los que se refieren a atributos claves del sistema de gobernanza del SSE. SAC= sistema adaptativo complejo (Figura modificada a partir de Gibbs. et al 2012).

6.3. Proceso de planificación y actores de interés

Una revisión reciente analizó diferentes iniciativas de PEMC alrededor del mundo (Collie et al. 2013), identificando características claves para un proceso exitoso, entre las que destacan la existencia de soporte legal con capacidades políticas para la implementación y de líderes del proceso eficaces en cuanto a promover la participación de actores de interés. Otro estudio analizó el apoyo y la oposición al establecimiento y funcionamiento de AMPs (Voyer et al. 2013), señalando como factores claves que han contribuido a la aceptación: la participación efectiva de actores de interés y la existencia de estructuras de gobernanza efectivas que incorporen soporte político y legal.

Es importante señalar que a diferencia de las reservas y parques marinos que tienen un estatuto jurídico reglamentario que se apoya en la Ley de Pesca, las AMCP-MU no se encuentran reguladas sistemáticamente en un cuerpo normativo de carácter general, en el cual se definan competencias, instrumentos de gestión o administración, fiscalización, financiamiento, sanciones en caso de incumplimiento, entre otros (Praus et al. 2011). Este vacío regulatorio y jurídico puede transformarse en una oportunidad para crear nuevos arreglos institucionales y de gobernanza para cumplir las metas y objetivos de manejo y conservación propuestos, y que pueden ser reflejados en el instrumento de gestión por excelencia que es el Plan General de Administración.

La inclusión de actores de interés en el proceso de planificación requiere definir al menos 3 aspectos: i) ¿quiénes deberían participar?, ii) ¿cuándo deberían participar?, y iii) ¿cómo deberían participar?. Respecto al *primer* aspecto, esta tesis abordó la identificación y caracterización de actores a través del análisis de redes de colaboración y conocimiento,

además de un análisis adicional de actores usando una matriz de influencia-capacidad, lo que permitió identificar actores claves para la planificación del AMCP-MU (Capítulo 4). Estos resultados debiesen ser utilizados como base para comenzar un proceso formal de planificación del AMCP-MU. El *segundo* aspecto trata con el ¿cuándo?. Esta tesis involucró los actores de interés en la identificación de otros actores relevantes en el manejo de recursos naturales en el área (Capítulo 4) y en la valoración de servicios ecosistémicos, características de biodiversidad, entre otros (Capítulo 5). Sin embargo, el involucramiento y participación efectiva de actores de interés puede y debiese ampliarse a otras fases del proceso de planificación e implementación (Fig. 6.2). El *tercer* aspecto corresponde a qué enfoques y técnicas pueden ser utilizados para incorporar a los actores en las diferentes etapas de la PEMC. Existe un amplio rango de enfoques de participación que van desde la interacción vertical entre los planificadores, autoridades y actores de interés (i.e., comunicación de resultados, decisiones o acciones de manejo a una audiencia de actores objetivo para esperar aprobación, pero sin involucrarlos mayormente) hasta interacción horizontal, donde planificadores y actores de interés pueden realizar una negociación en igualdad de condiciones respecto al poder para la toma de decisiones (Pomeroy & Douvere 2008, Ehler & Douvere 2009, Maguire et al. 2012).

Del mismo modo que no es obligatoria o necesaria la participación de todos los actores de interés o en todos los pasos del proceso, los enfoques no necesariamente deben ser similares para todos los grupos de actores o en todos los pasos del proceso. Aportes de los actores de interés pueden ser obtenidos no sólo en el proceso de toma de decisiones propiamente tal. En esta tesis se obtuvo información sobre componentes del sistema socio-ecológico para contribuir a definir las condiciones existentes, así como también, escenarios deseados o

expectativas respecto al funcionamiento de la futura AMCP-MU. Ejemplos de ello, lo constituyen los análisis de actores y de redes (Capítulo 4), la valoración y priorización de servicios ecosistémicos y características de biodiversidad, la percepción de amenazas y las expectativas respecto al funcionamiento de la futura AMCP-MU por parte de los actores de interés (Capítulo 5). En el caso de actores que son usuarios directos de recursos, es relevante integrar el conocimiento ecológico tradicional y local que ellos poseen (e.g., pescadores), como por ejemplo, información espacial respecto a áreas de relevancia para la conservación, rutas de cetáceos, caladeros de pesca, entre otros (P.F. Cárcamo, datos no publicados), información que puede ser complementaria a la información científica para la planificación de la conservación (Ban et al. 2009). Posteriormente. actores de interés, usuarios, comunidades locales o voluntarios pueden contribuir en el monitoreo de planes y medidas derivadas del PEMC, como ha sido demostrado, por ejemplo, en el monitoreo de AMPs (Pomeroy et al. 2005), especies amenazadas (Lorenzo et al. 2011) y basura de origen antropogénico en costas (Bravo et al. 2009). Adicionalmente, el uso de nuevas tecnologías (e.g., internet, GPS, teléfonos inteligentes, redes virtuales) pueden contribuir a aumentar y sistematizar el aporte ciudadano al monitoreo y vigilancia de los ecosistemas (Newman et al. 2012).

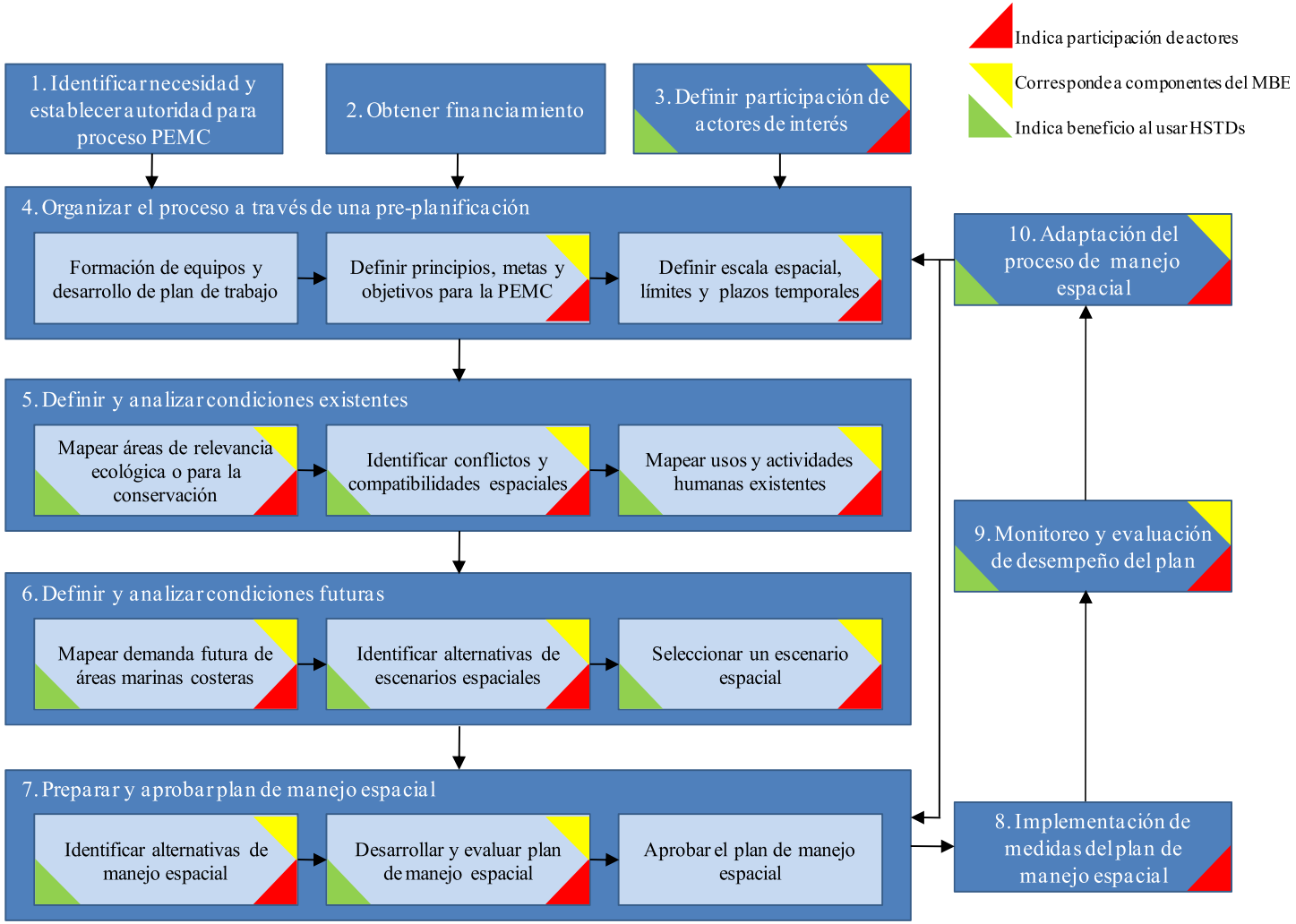

Fig. 6.2. Pasos o etapas para el desarrollo de un proceso de PEMC. HSTD= Herramienta de soporte o apoyo para la toma de decisiones (Elaborado a partir de Ehler & Douvere 2009, Foley et al. 2010, Coleman et al. 2011, Maguire et al. 2012).

6.4. Escala espacial para el manejo del AMCP-MU

Los ecosistemas marinos costeros son altamente complejos, considerando las múltiples conexiones e interacciones que ocurren a través de diversas escalas espaciales y temporales (McLeod & Leslie 2009, Roff & Zacharias 2011). Dada la complejidad inherente a estos ecosistemas y la dificultad para predicciones, delimitar una escala apropiada y posible para el manejo requiere de un entendimiento e inclusión de aspectos que van desde los institucionales (e.g., redes de gobernanza, límites administrativos y jurisdiccionales) hasta los ecológicos y físicos (e.g., distribución de especies, dispersión, conectividad, corrientes marinas). La elección del área propuesta para AMCP-MU (forma y extensión) se ha justificado, principalmente, por el sistema de islas, sus áreas protegidas y de manejo, su productividad biológica y pesquera, y las amenazas y presiones a las que está sometida (Oceana 2010). En el capítulo 2 y 4 de esta tesis se abordó el ajuste funcional entre el área del AMCP-MU y las dimensiones institucionales que imponen las actuales estructuras político-administrativos (i.e., el AMCP-MU abarca dos comunas y dos regiones diferentes) concluyendo sobre el bajo ajuste funcional existente y la necesidad de mejorar el flujo en las redes de colaboración e intercambio de conocimiento, para así, dar mejor gobernanza y manejo al área.

Uno de los aspectos claves y ampliamente reconocidos para el diseño, planificación y manejo de las AMPs lo constituye la comprensión de las vías de dispersión y la conectividad poblacional (Gell & Roberts 2003, Palumbi 2003, Cowen & Sponaugle 2009). La diversidad en ciclos e historia de vida de los organismos marinos agrega complejidad al estudio de la conectividad entre áreas y/o poblaciones (Sherman et al. 2008, Shanks 2009, Toonen et al. 2011). Como ejemplo, el loco *C. concholepas* y las ballenas, especies altamente priorizadas

para su conservación y manejo por los actores de interés (Capítulo 5), poseen características de dispersión, movimiento y conectividad contrastantes. Mientras el primero posee una fase larval planctónica de larga duración, un gran potencial de dispersión (Disalvo & Carriker 1994) y su transporte está sujeto principalmente a las condiciones oceanográficas imperantes (Poulin et al. 2002, Molinet et al. 2005), las segundas, corresponden a organismos que carecen de fase larval pelágica, pero tienen el potencial de moverse ampliamente a través de los océanos y fuera de los límites de cualquier AMP, enfrentando pocas barreras para su dispersión (Branch et al. 2007, Block et al. 2011). Sin embargo, y a pesar de las posibilidades de movimiento y dispersión a grandes distancias en la mayoría de las especies marinas, los límites geográficos de dicha dispersión siguen siendo bastante inciertos (Toonen et al. 2011). Una AMP con baja dispersión y conectividad con otras áreas adyacentes, puede limitar seriamente la capacidad de ésta para aumentar la productividad en las pesquerías, debido a que los propágulos pueden quedar atrapados dentro de los límites del área protegida (Palumbi 2003, Gerber et al. 2005, Bell 2008). Gell & Roberts (2003) señalan que la efectividad de las AMPs dependerá en parte de la conectividad con otras áreas y la exportación de biomasa hacia áreas no protegidas. Entonces, será fundamental avanzar en estudios de conectividad y exportación de biomasa entre reservas marinas, AMERBs y áreas de libre acceso para la pesca existentes dentro del área propuesta como AMCP-MU. La propuesta espacial del AMCP-MU (o una redefinición de sus límites) no incluirá completamente la distribución espacial o el ámbito de hogar de especies altamente migratorias (e.g., cetáceos), y probablemente tampoco, el de fases larvales de algunos invertebrados o peces. En el caso de cetáceos migratorios como la ballena jorobada o de aleta, frecuentemente avistadas en las inmediaciones de las reservas marinas y dentro del área propuesta de AMCP-MU (Pérez et al. 2006, Luna-Jorquera et al.

2013), la implementación del AMCP-MU no aseguraría su viabilidad poblacional, pero si está en el contexto de un manejo regional o de una red regional de AMPs, sería una gran contribución a fases de la historia de vida críticas como son la alimentación y la migración (Hucke-Gaete et al. 2013).

La planificación y la producción de escenarios de manejo espacial (e.g., zonificación) para el AMCP-MU debe considerar imperiosamente: i) la existencia de reservas marinas y AMERBs (difíciles de desafectar) y sus interacciones (Capítulo 2), ii) las fuertes conexiones e interacciones (inherentes) entre tierra-mar (Capítulo 2; Álvarez-Romero et al. 2011), y iii) las presiones y amenazas que vienen desde las actividades y usos realizados en tierra (Tallis et al. 2008, Cárcamo et al. 2011). Dada las limitaciones de planificación espacial en tierra que tiene la AMCP-MU, posibles efectos negativos por parte de actividades en tierra debiesen ser considerados en las estrategias de planificación y manejo de mayor cobertura espacial (e.g., estrategias regionales). Cobra más relevancia aún, si consideramos que tanto el área marina costera del AMCP-MU como el área terrestre próxima han sido consideradas como altamente relevantes para la conservación regional y nacional de la biodiversidad (Squeo et al. 2009, Squeo et al. 2010). Evaluaciones y modelaciones de amenazas transversales (o que se originan en tierra) y sus posibles efectos sobre la costa, deben ser consideradas en la planificación del AMCP-MU y en evaluaciones ambientales de actividades productivas que ingresan al Servicio de Evaluación Ambiental.

6.5. Herramientas de apoyo para la toma de decisiones

En la actualidad existe una amplia gama de herramientas (e.g., métodos, softwares, aplicaciones basadas en internet) que pueden asistir los procesos de toma de decisiones para el logro de metas de conservación y manejo, reduciendo la incerteza y el riesgo ecológico. La variedad de herramientas existentes y el criterio para incorporarlas y utilizarlas, puede darle al proceso de planificación un carácter interdisciplinario y participativo como el promovido en el MBE. Estas herramientas pueden estar asociadas y beneficiar diferentes etapas del proceso de planificación (Fig. 6.2), incluyendo herramientas que van desde el análisis de actores hasta herramientas para la cuantificación y modelación de servicios ecosistémicos[16]. En la PEMC, donde la generación de planes espaciales o esquemas de zonificación son productos esperables, el análisis de datos geográficos espaciales juega un rol clave, por ejemplo, para determinar áreas óptimas para conservación o preservación. Tecnologías y sistemas de información geográfica (SIG) han aumentado en sofisticación, pero también se han hecho accesibles a la participación y posibilidad de visualización e interpretación por parte de participantes no-expertos (Merrifield et al. 2013). Existe reconocimiento que la PEMC se beneficia enormemente de sistemas de apoyo a las decisiones espaciales (Ehler & Douvere 2009, Coleman et al. 2011, Portman et al. 2013, Stelzenmüller et al. 2013b), como por ejemplo, métodos cuantitativos y herramientas computacionales para priorización espacial y planificación sistemática de la conservación marina y terrestre ampliamente utilizadas en la actualidad como Marxan, Marxan with Zones, Zonation, entre otros (Moilanen et al. 2009).

[16]Una compilación de herramientas para asistir el MBE y PEMC se encuentra en http://www.ebmtoolsdatabase.org/tools

Otras iniciativas recientes como MarineMap[17] y SeaSketch[18] corresponden a herramientas de planificación costera basadas en internet que proporcionan oportunidades para la exploración de datos espaciales, permitiendo de manera simultánea la participación de actores y la comparación de soluciones espaciales propuestas por usuarios versus soluciones a partir de criterios científicos.

De acuerdo con los resultados y conclusiones de esta tesis, la utilización de herramientas de apoyo a las decisiones espaciales debiesen estar guiadas por al menos tres principios: i) reconocimiento e integración de relaciones entre presiones humanas y componentes ecosistémicos, ii) procesos transparentes e inclusivos, y iii) necesidad de reflejar espacialmente valores y necesidades de los diversos actores de interés.

6.6. Interdisciplinariedad y manejo basado en ciencia para el AMCP-MU

Como indica Ostrom (2009), todos los recursos utilizados por los humanos forman parte de sistemas socio-ecológicos complejos. Por ello, para el proceso de PEMC bajo el enfoque del MBE siempre será crítico disponer de información ecológica y social (Foley et al. 2010, Ban et al. 2013). En gran parte de esta tesis se ha señalado la importancia de la participación de actores de interés en la toma de decisiones y planificación sobre recursos naturales. Como señala Moran (2011), la investigación que integra al hombre y su ambiente (i.e., ciencia de la sustentabilidad) es un enfoque necesario para lidiar con los desafíos que imponen los sistemas socio-ecológicos acoplados y la toma de decisiones sobre ellos. En la actualidad, no existe mayor debate respecto a la inclusión de las ciencias sociales en el desarrollo de la

[17]www.marinemap.org
[18]www.seasketch.org

conservación de la biodiversidad y planificación sobre recursos naturales, sino más bien, en cómo éstas deben ser incorporadas (Mascia et al. 2003, Newing 2011, Koehn et al. 2013). No todas las etapas del proceso de PEMC requieren un aporte considerable de información científica (Ehler & Douvere 2009, Stelzenmüller et al. 2013a). Los principales aportes, tanto de las ciencias naturales como de las sociales, son requeridos en las etapas de evaluación inicial (i.e., condiciones existentes), de desarrollo de escenarios alternativos de manejo espacial y propuestas de zonificación (i.e., condiciones deseadas o futuras), y de monitoreo y evaluación del funcionamiento de los planes para manejo adaptativo (Ehler & Douvere 2009, McLeod & Leslie 2009, Foley et al. 2010, Stelzenmüller et al. 2013b).

La propuesta de AMCP-MU La Higuera-Isla Chañaral corresponde a un área con una cantidad apreciable de investigación científica si se compara con otras áreas costeras de Chile, sin embargo, los esfuerzos integrales o interdisciplinarios para orientar la planificación aún son escasos. En el capítulo 4 de esta tesis, se investigó la red de intercambio de conocimiento científico útil para el manejo y conservación de recursos naturales, y si bien en la actualidad se encuentra poco conectada, posee numerosos actores productores de ciencia (e.g., universidades, centros de investigación regional y ONGs para la conservación de la biodiversidad) que permitirían mejorar el flujo y la productividad científica con efectos positivos para el manejo del AMCP-MU.

En el contexto del MBE, la producción científica debe acercarse a la práctica del manejo, para así, mejorar la comunicación y disminuir la brecha histórica existente. Kaufman et al. (2009) señalan que en la actualidad se reconoce que es posible y éticamente responsable, que la comunidad científica se involucre más en temas de manejo y diseño de políticas, sin que esto signifique imparcialidad y pérdida de rigurosidad científica. De ahí que exista un desafío

permanente de traducir investigación científica a ciencia en acción y de traducir resultados a maneras simples y útiles para procesos de toma de decisiones.

6.7. Elementos claves para construir una estrategia de manejo basado en ecosistemas para el AMCP-MU La Higuera-Isla Chañaral

Es indudable que la planificación e implementación del AMCP-MU La Higuera-Isla Chañaral bajo el enfoque del MBE será un proceso demandante de tiempo, coordinación, financiamiento, información científica y voluntades, entre otros, algo imposible de abarcar en una tesis doctoral. Esta tesis planteó desarrollar una estrategia de MBE para el AMCP-MU La Higuera-Isla Chañaral, y como respuesta a este objetivo y como estrategia general, se recomienda que la implementación del AMCP-MU sea abordada a través de un proceso de planificación tipo PEMC, altamente participativo y considerando las particularidades del sistema socio-ecológico asociado. La planificación tipo PEMC se justifica principalmente en la multiplicidad de usos, actores y presiones existentes en el área y en la estructura que da este tipo de planificación a los procesos de toma de decisión. La participación, especialmente la temprana, se justifica en los beneficios de ella en la aceptación y efectividad de medidas de manejo y conservación reportadas en la literatura, en la existencia de redes sociales asociadas al área descritas en este estudio, y en la auto-percepción de los diversos actores de interés respecto a su importancia e interés en la toma de decisión. Las particularidades del sistema socio-ecológico dice relación principalmente con la consideración de temas como: la existencia previa de medidas de manejo y conservación que se encuentran funcionando al interior del área propuesta para AMCP-MU, la pesca artesanal como un uso tradicional e

histórico predominante en el área, el ecoturismo como nuevo motor de desarrollo económico de las comunidades locales, y las presiones ambientales y conflictos sociales que se han generado y continúan por la instalación de proyectos industriales asociados a la costa.

Existen diferentes marcos propuestos para desarrollar la PEMC (e.g., Fig. 6.2), pero todos incluyen al menos las siguientes etapas: i) definición de la región a planificar; ii) establecimiento de principios, objetivos y metas que guían el proceso de planificación; iii) definición de condiciones existentes y futuras en el sistema socio-ecológico; iv) propuesta de escenarios alternativos de planificación; v) implementación de planes; vi) monitoreo y evaluación del plan; y vii) adaptación del plan (Crowder & Norse 2008, Day 2008, Blæsbjerg et al. 2009, Douvere & Ehler 2009, Ehler & Douvere 2009, Collie et al. 2013, Portman et al. 2013). Las cuatro primeras etapas están asociadas al ejercicio de planificación propiamente tal. Esta tesis generó información útil para su desarrollo, sin embargo, acciones adicionales son necesarias para complementarlas y consolidarlas en un contexto de planificación oficial (Tabla 6.1). En general, existe una necesidad de validar información a través de procesos oficiales y participativos.

Luego, para otorgarle enfoque de MBE al proceso de planificación del AMCP-MU se deben considerar ciertos elementos claves, al menos en el proceso inicial de planificación. Algunos de ellos han sido abordados en esta tesis, y para otros, existe información previa con diferentes niveles de desarrollo y profundidad. Lo anterior implica que no todos los elementos claves exhiben niveles homogéneos de información para la toma de decisiones y que su desarrollo no necesariamente debe o puede ser abordado simultáneamente. Una serie de preguntas asociadas a cada elemento puede servir como indicadores de la calidad de la información disponible y de

su utilidad para el proceso de implementación y/o toma de decisiones, y también, para orientar los esfuerzos futuros de investigación.

Un tema no profundizado en esta tesis, pero que es fundamental y transversal al proceso de implementación del AMCP-MU, corresponde a la disponibilidad de recursos financieros y humanos para su planificación, implementación y administración. Como se señaló anteriormente, la existencia de vacíos jurídicos para este tipo de AMP implica que a la fecha no exista un modelo de administración ni de financiamiento definido para implementarlas, aunque las fórmulas propuestas para las AMCP-MUs existentes han sido modelos de administración con integración público-privada. Es importante destacar que de las tres AMCP-MUs establecidas en las costas chilenas ninguna se encuentra aún completamente implementada (Jorquera-Jaramillo et al. 2012). Tampoco existe una institución o agencia única legalmente encargada del proceso de planificación o implementación. Por lo tanto, los desafíos en cuanto a estructura administrativa y financiera son mayores para lograr una planificación y gobernanza eficaz del AMCP-MU. En cualquier caso, el modelo de administración y financiamiento debiese apuntar hacia una autonomía y sostenibilidad que permita dar continuidad a las metas y objetivos planteados a mediano y largo plazo. Para ello se deben buscar fórmulas innovadoras que permitan recoger fondos desde diversas fuentes, como por ejemplo, fondos regionales, fondos institucionales, prestación de servicios, fondos internacionales, alianzas para el desarrollo de estudios científicos.

Probablemente el futuro Servicio de Biodiversidad y Áreas Protegidas, contemplado en el marco de la nueva institucionalidad ambiental chilena, pueda jugar un rol clave para la administración de las AMCP-MUs en Chile.

Tabla 6.1. Principales aportes de esta tesis al proceso de planificación del AMCP-MU La Higuera-Isla Chañaral.

Etapa	Aporte de esta tesis	Acción complementaria sugerida
Definición de la región a planificar.	-Descripción ecológica y socio-económica del área.	-Validación por actores de interés del área geográfica propuesta.
Establecimiento de principios, objetivos y metas que guían el proceso de planificación.	-Identificación de percepciones sobre características de biodiversidad, servicios ecosistémicos, usos humanos y amenazas.	-Validación a través de un proceso participativo de una visión común para el AMCP-MU. -Definición del modelo de administración, manejo y gobernanza para el AMCP-MU. -Diseño de un plan de financiamiento para la planificación e implementación. -Definición del organismo administrador para el AMCP-MU.
Definición de condiciones existentes y futuras en el sistema socio-ecológico.	-Caracterización de los sistemas de manejo y gobernanza existentes. -Identificación de principales interacciones ecológicas e institucionales. -Caracterización de redes sociales de organizaciones/instituciones asociadas al área del AMCP-MU. -Identificación de actores claves para la implementación del AMCP-MU. -Auto-percepción de actores de interés sobre la	-Estudio de conectividad poblacional de especies marinas claves, y entre áreas de manejo y reservas. -Estudio de impacto del turismo en el sistema socio-ecológico. -Valoración económica de bienes y servicios ecosistémicos proporcionados por el área. -Validación de líderes para el proceso de planificación y actores de interés (¿quiénes lideran? ¿quiénes participan?).

	importancia en la toma de decisiones. -Expectativas sobre funcionamiento del AMCP-MU -Priorización de características de biodiversidad, servicios ecosistémicos y usos humanos.	
Propuesta de escenarios alternativos de planificación.	-Identificación de potenciales objetos de conservación y manejo.	-Validación de objetos de conservación. -Definición de metas de conservación y regulaciones a usos humanos. -Evaluación de *trade-offs* (compatibilidades e incompatibilidades), por ejemplo, entre usos y servicios ecosistémicos existentes o propuestos en diferentes escenarios de manejo. -Iniciar proceso de planificación sistemática de la conservación para el AMCP-MU. -Planificación espacial o zonificación de actividades. -Desarrollo del Plan General de Administración.

Tabla 6.2. Elementos claves a considerar para dar enfoque de MBE en la planificación del AMCP-MU La Higuera-Isla Chañaral. Ejemplos de preguntas que pueden servir como indicadores de la calidad de la información disponible y como orientación para los futuros esfuerzos de investigación (Elaboración propia a partir de revisión literatura sobre MBE).

Elemento del MBE	Preguntas para orientar calidad de información en contexto del MBE
Servicios ecosistémicos	- ¿Cuáles servicios ecosistémicos son proporcionados y dónde son producidos?* - ¿Qué nivel de beneficios desde los servicios ecosistémicos (cuali o cuantitativo) son recibidos por la gente?* - ¿Cuáles servicios ecosistémicos son necesitados y priorizados por la gente para mantener su provisión?* - ¿De qué manera útil para el manejo pueden ser medidos los diferentes servicios ecosistémicos?* - ¿Cómo los servicios ecosistémicos han cambiado en el tiempo? - ¿Qué metas cuantitativas deberían ser establecidas para los diferentes servicios ecosistémicos? - ¿Cómo la provisión de diversos servicios ecosistémicos cambiaría bajo diferentes escenarios de manejo?
Información científica natural y social	- ¿De qué manera las especies y los procesos ecológicos generan servicios ecosistémicos? - ¿De qué manera las actividades humanas afectan los servicios ecosistémicos?* - ¿Cómo podemos usar modelos y el monitoreo científico para medir los cambios en la provisión de servicios ecosistémicos producto de las acciones de manejo?
Interacciones ecológicas	- ¿Existe un modelo conceptual para los diversos componentes ambientales y sus interacciones que sea accesible como herramienta para la toma de decisiones?* - ¿Cuáles son las interacciones ecológicas claves que deben ser priorizadas en la toma de decisiones? - ¿Cuáles son los *trade-offs* y efectos acumulativos que pueden derivarse de estas interacciones ecológicas? - A partir de las interacciones ecológicas ¿Cómo podemos ajustar las políticas, regulaciones y acciones de

	manejo para mantener o mejorar la provisión de servicios ecosistémicos?
Impactos acumulativos	- ¿De qué manera las actividades humanas (aisladas o combinadas) afectan y ponen en peligro la provisión de servicios ecosistémicos?* - A partir del conocimiento de los impactos acumulativos de las diversas actividades humanas ¿Cómo podemos ajustar las políticas, regulaciones y acciones de manejo para mantener o mejorar la provisión de servicios ecosistémicos?
Trade-offs entre actividades humanas	- ¿Qué *trade-offs* ocurren o podrían ocurrir entre las actividades humanas actuales y potenciales en el área? - ¿Qué *trade-offs* ocurren entre las actividades humanas y la provisión de servicios ecosistémicos?* - ¿Cómo podemos cuantificar los diversos *trade-offs* de manera útil para la toma de decisiones?
Escala espacial	- ¿Cuáles son las zonas dentro del área del AMCP-MU que producen los diversos servicios ecosistémicos? - ¿Cuáles son las áreas colindantes que pueden afectar o ser afectadas por el AMCP-MU? - ¿Qué datos están disponibles para la integración, a través de diversas escalas geográficas, y posterior comprensión de las características naturales y las dimensiones humanas del AMCP-MU? - ¿Qué medidas existen y qué organizaciones están trabajando en elementos del MBE dentro del AMCP-MU o en regiones más grandes, y cómo podemos compartir conocimiento, alinear objetivos y tomar medidas complementarias?*
Actores de interés	- ¿Quiénes son las personas y organizaciones que tienen un interés o son afectados por el AMCP-MU?* - ¿Quiénes son las personas y organizaciones que usan o se benefician de los servicios ecosistémicos?* - ¿Cómo podemos fomentar la interacción entre personas, organizaciones e instituciones para definir una visión para el futuro y las metas para planificar el AMCP-MU?* - ¿Cómo podemos establecer una red social asociada al AMCP-MU que facilite la comunicación de la información e ideas entre las diversas personas, organizaciones e instituciones?*

*Temas abordados en esta tesis

Capítulo 7. Conclusiones

7.1. Principales conclusiones

La planificación, manejo y conservación efectiva de los ecosistemas costeros requiere de un enfoque que considere e integre los aspectos ecológicos, sociales, económicos e institucionales del sistema a ser intervenido, para así, abordar la complejidad de la dimensión humano-ambiente con potenciales beneficios para el cumplimiento de metas y objetivos definidos. Esta tesis contribuyó, por un lado, a mejorar la comprensión del sistema socio-ecológico que soporta el área propuesta para AMCP-MU, y por otro, a generar información y proporcionar métodos, herramientas y recomendaciones prácticas para la implementación del AMCP-MU bajo el enfoque del MBE.

Con el desarrollo del Capítulo 2 se concluye que el estudio de las interacciones ecológicas, socio-económicas e institucionales, más allá de las existentes dentro de cada medida de conservación o manejo (e.g., reservas o AMERBs), es un insumo valioso para mejorar su propio funcionamiento y la sustentabilidad del sistema socio-ecológico más amplio que los soporta. Esta concepción de sistema dentro de sistemas, de alta conexión y de incrustación de las AMPs (concepción necesaria para su efectividad) nos orienta respecto a la construcción de los sistemas de gobernanza y el diseño de cualquier acción de manejo.

El Capítulo 3 nos muestra que la legislación chilena escasamente da cuenta o reconoce las fuertes relaciones existentes entre diferentes componentes (e.g., servicios ecosistémicos, amenazas y usos humanos) del ecosistema del AMCP-MU, dificultando la aplicación de un MBE. Sin embargo, el análisis de diversos instrumentos disponibles en la legislación chilena para el manejo, planificación y conservación de recursos naturales demostró las aptitudes de instrumentos como el AMCP-MU para su aplicación.

En el Capítulo 4 y a través del análisis de actores de interés y redes sociales de colaboración e intercambio de conocimiento, se identificaron actores claves para el proceso de implementación, pero también, se determinaron ciertas características y propiedades estructurales de las redes que de no ser abordadas podrían dificultar la gobernanza del AMCP-MU.

En el capítulo 5 se explora un tema fundamental para la planificación del AMCP-MU y principio transversal del MBE, la participación de actores sociales de interés en la identificación y definición de objetivos y posibles objetos de conservación. Valoración de servicios ecosistemicos, características de biodiversidad, usos y amenazas, componentes esenciales para la planificación, fueron investigados entre grupos de actores de interés. Se concluye que la condición de usuario tradicional directo y la cercanía espacial del grupo de pescadores artesanales con los componentes ecosistémicos evaluados, fueron factores que explican diferencias en valoración y priorización con otros grupos. Situación que debe ser considerada en la planificación. En ese capítulo además, se mostraron las altas expectativas de efectividad, en cuanto al manejo y conservación, que genera entre los diversos actores la implementación del AMCP-MU.

Finalmente, en el análisis del Capítulo 6 se recomienda que la implementación del AMCP-MU bajo el enfoque de MBE debería ser logrado a través de un proceso de planificación tipo PEMC, altamente participativo y considerando las particularidades del sistema socio-ecológico. De este modo, se puede avanzar en una estrategia de MBE para el AMCP-MU donde la conservación de la biodiversidad sea central al proceso de PEMC, evitando así su transformación en una "AMP de papel" (Rife et al. 2013).

7.2. Aplicación de resultados de esta tesis

La pregunta que originalmente dio origen a esta tesis fue cómo avanzar hacia un nuevo enfoque que permita un manejo y gobernanza efectivos de las costas chilenas teniendo como eje central la conservación de la biodiversidad y considerando las particularidades y complejidades de los sistemas socio-ecológicos de soporte. Luego, el objetivo general planteó desarrollar una estrategia de MBE para el AMCP-MU La Higuera-Isla Chañaral, y si bien, la planificación e implementación del AMCP-MU será un proceso largo, imposible de seguir instantáneamente en una investigación de tesis, se ha generado información útil para caracterizar las condiciones existentes, proyectar condiciones y escenarios futuros o deseados, y para la definición de elementos estratégicos claves para orientar el proceso de planificación y manejo. Varios resultados de esta tesis debiesen ser aportes relevantes al menos para las primeras etapas del proceso oficial y futuro de planificación del AMCP-MU, como por ejemplo: i) a partir de la caracterización del sistema social y de gobernanza del área a través del análisis de actores sociales y de redes los líderes de la planificación pueden identificar los actores relevantes para comenzar el proceso, ii) a partir de la valoración y priorización de servicios ecosistémicos, características de biodiversidad y usos humanos se obtienen insumos para comenzar a definir una visión común para el área, y iii) a partir de estos últimos componentes valorizados y priorizados se pueden definir objetos y metas de conservación y comenzar una planificación sistemática de la conservación con la posterior identificación de áreas prioritarias y desarrollo de planes espaciales o esquemas de zonificación.

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Anexos

ANEXO 2.1. Official documents related to SECMMs in the area of Punta de Choros

ICHD-MR

- General Law of Fisheries and Aquaculture (GLFA) (1991) and subsequent amendments
- Regulation of Parks and Marine Reserves (2005) and subsequent amendments
- Executive Report. Application of Management System of Chilean Marine Reserves Network (SERNAPESCA) (2011)
-General Administration Plan (2010)
-Statement of environmental impact, General Administration Plan (2010)
-SUBPESCA Technical Report. Foundations for declaration ICHD-MR (2005)
-Declaration decree (2005)
-Regulation and Uses Zoning of ICHD-MR (draft)(2011)
-Minutes from workshops ICHD-MR (2009-2011)

MEABRs

-General Law of Fisheries and Aquaculture (GLFA) (1991) and subsequent amendments
-Regulations on MEABRs (1995) and subsequent amendments
-Technical Document Nº 3. Technical considerations for studies in MEABRs. SUBPESCA (2001)
-Declaration decree, baselines studies, management plans, monitoring reports.

HPNR

-Management Plan. CONAF (1997)
-Management Plan. CONAF (2007)
-Creation decree (1990)
-Method for management planning SNASPE units. CONAF (2003)
-Handbook of procedures, requirements and obligations for scientific research projects in SNASPE units. CONAF
-Operating Manual for recreational activities in SNASPE units. CONAF

IG-NPA

-Creation decree (2006)
-Diagnosis Sectional Plan Gaviota Island, Municipality of La Higuera. Regional Secretary of Housing and Urbanism of Coquimbo, Municipality of La Higuera (2008)

OTHERS

-Tourism development plan of Municipality of La Higuera (2010)
-Communal development plan of Municipality of La Higuera (2010)
-Tourism Annual Report 2010. SERNATUR (2011)
-Public minutes of Fisheries Zonal Council
-General regulation for bird, cetacean and reptile watching (SUBPESCA 2011)

ANNEX 2.2. Tourism in the Punta de Choros study area

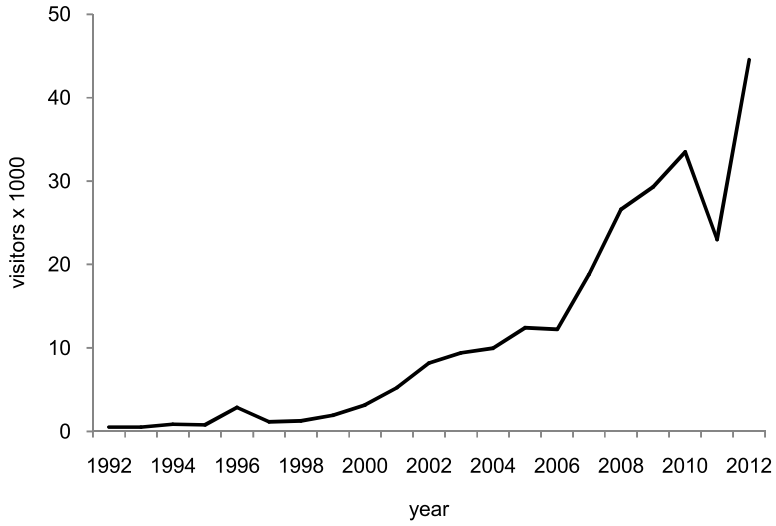

Fig. 1 Visitors entry into the HPNR (compiled by the authors from CONAF data).

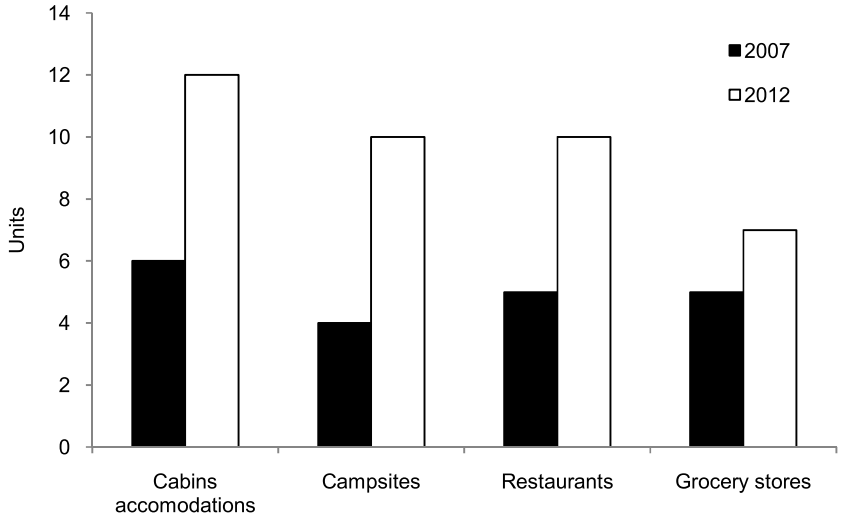

Fig. 2 Tourism-related services in 2007 (Gaymer et al. 2008) and 2012 (present study) in the village of Punta de Choros.

ANEXO 2.3. Effectiveness of Management Areas

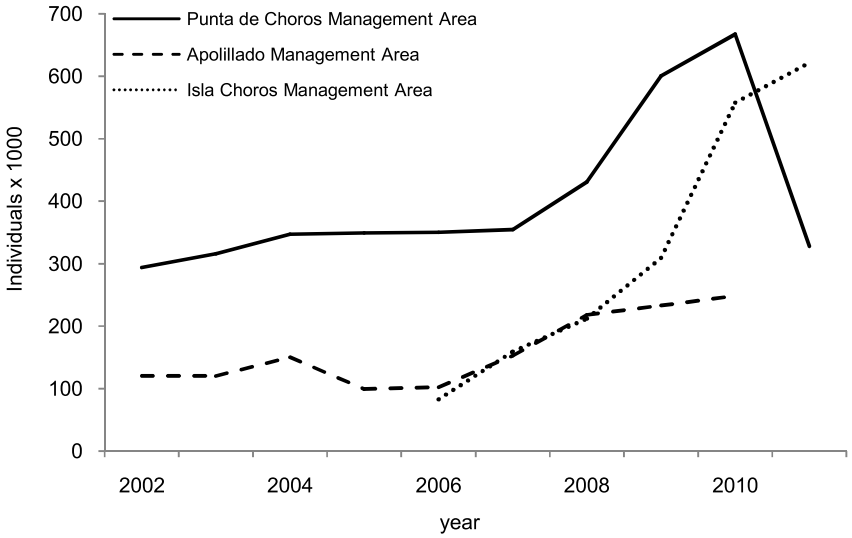

Fig. 1. Estimates of catch quotas for *C. concholepas* (thousands of individuals) in Management Areas (compiled by the authors from Management Areas monitoring reports).

ANEXO 3.1. List of terms and phrases that represent concepts in the ecosystem model

" "= term or phrase matching the exact phrase in document. * Wildcard matching (e.g., dun* will match dune, dunes, etc.)

Group	**Component** (Term set l)	**Term set 2** (additional terms to represent concept, originally in spanish)
ecoystem services	flagship species habitat	Habitat "migratory route" "nesting area"
	kelp	"brown algae" "brown macroalgae" phaeopyta Lessonia huiro Macrocystis
	wildlife watching	"nature watching" "flora and fauna watching" "whale watching" "bird watching"
	beaches	beach*
	diving areas	"diving zone"
	research	Universities "research center"
	fishing grounds	"natural bank"
	dunes	dun*
	renewables energies	"Non-Conventional Renewable Energy"
Threats	illegal fishing	"prohibited fishing"
	trawling	trawl*
	maritime traffic	"maritime route" "navigation route" "ship traffic"
	marine pollution	"trash on beach" "trash on sea"
	power plants	"coal-fired power plant"
	invasive species	Pests
	climate change	"rising sea temperature" "sea level rise"
	dumps	landfills
	coastal residential development	"coastal development" "coastal regulator plan" "waterfront land"
uses/activities	artisanal fishing	"artisanal fishermen" "artisanal fishing quota"
	industrial fishing	"industrial fleet" "industrial fishing quota"
	kelp harvesting	"algae harvest*" "macroalgae harvest*" "kelp extraction"
	recreational diving	"sport diving" "touristic diving" spearfishing "diving championship"
	management areas	"management areas" MEABR
	aquaculture	aquaculture "marine culture" "sea farm" "marine farm*"
	tourism in MPAs	"tourism in protected areas" "tourism boat" "tourism in marine protected areas"
	ports	port*
	MPAs	"marine reserve" "marine protected area"
	terrestrial reserves	"national reserve" "terrestrial park" "national park"
	ecotourism	"nature tourism" "ecotouristic potential" trekking hiking "horseback riding"
	restocking	"ecosystem restoration" "nature restoration"

ANEXO 3.2. Collection of legal documents directly or indirectly associated to the identified environmental components. Legal documents were categorized according to their scope of application

Scope of application	**Number**	**Percentage**
Fisheries and aquaculture	30	16.3
International environmental and conservation agreements	24	13.0
Institutional statutes	18	9.8
Protected areas	14	7.6
Environmental law	13	7.1
Regional development strategy	8	4.3
Health code	7	3.8
Forests and soils	6	3.3
Hunting	6	3.3
Maritime navigation	6	3.3
Marine pollution	5	2.7
Tourism	5	2.7
Coastal border zoning	5	2.7
Maritime concessions	4	2.2
Citizen participation	4	2.2
Urban planning	4	2.2
Biodiversity strategy	3	1.6
Water	3	1.6
Energy	3	1.6
Local government	3	1.6
Native people	3	1.6
National assets	2	1.1
Civil code	2	1.1
Agricultural communities	2	1.1
Mining	2	1.1
Communal planning	2	1.1

ANEXO 3.3. Document collection

File ID	Document Description	Agency Involvement	Year	Location	Document Type
A71-002.txt	PROHIBICION DE INGRESO Y TRANSITO DE VEHICULOS EN SECTORES DEL BORDE COSTERO, RIOS Y LAGOS	DIRECTEMAR	2001	CH	Regulación
DFL-1_07-SEP-1992.txt	MODIFICA LA ESTRUCTURA ORGANICA DE LA SUBSECRETARIA DE PESCA Y DEL SERVICIO NACIONAL DE PESCA	MINECON	1992	CH	Estatutos
DFL-1_26_JUL-2006.txt	FIJA EL TEXTO REFUNDIDO, COORDINADO Y SISTEMATIZADO DE LA LEY Nº 18.695, ORGANICA CONSTITUCIONAL DE MUNICIPALIDADES	MININ	2006	CH	Estatutos
DFL-1_30-MAY-2000.txt	FIJA TEXTO REFUNDIDO, COORDINADO Y SISTEMATIZADO DEL CODIGO CIVIL	MINJUS	2000	CH	Código
DFL-1122_29-OCT-1981.txt	FIJA TEXTO DEL CODIGO DE AGUAS	MINJUS	1981	CH	Código
DFL-2_20-ABR-2011.txt	MODIFICA ESTRUCTURA ORGÁNICA DEL SERVICIO NACIONAL DE PESCA	MINECON	2011	CH	Estatutos
DFL-292_05-AGO-1953.txt	APRUEBA LA LEY ORGANICA DE LA DIRECCION GENERAL DEL TERRITORIO MARITIMO Y DE MARINA MERCANTE	MINH	1953	CH	Estatutos
DFL-294_05-ABR-1960.txt	ESTABLECE FUNCIONES Y ESTRUCTURA MINISTERIO DE AGRICULTURA	MINH	1960	CH	Estatutos
DFL-302_06-ABR-1960.txt	APRUEBA DISPOSICIONES ORGANICAS Y REGLAMENTARIAS DEL MINISTERIO DE MINERIA	MINH	1960	CH	Estatutos
DFL-340_06-ABR-1960.txt	DECRETO CON FUERZA DE LEY N° 340 SOBRE CONCESIONES MARITIMAS	MINH	1960	CH	Regulación
DFL-382_21-JUN-1989.txt	LEY GENERAL DE SERVICIOS SANITARIOS	MINOP	1988	CH	Regulación
DFL-5_15-NOV-1983.txt	FIJA TEXTO REFUNDIDO, COORDINADO Y SISTEMATIZADO DEL DECRETO CON FUERZA DE LEY 34, DE 1931, QUE LEGISLA SOBRE LA INDUSTRIA PESQUERA Y SUS DERIVADOS	MINECON	1983	CH	Estatutos
DFL-5_17-ENE-1968.txt	MODIFICA, COMPLEMENTA Y FIJA TEXTO REFUNDIDO DEL D.F.L. R.R.A. N° 19, COMUNIDADES AGRICOLAS	MINAG	1967	CH	Estatutos
DFL-725_31-ENE-1968.txt	CODIGO SANITARIO	MINSAL	1967	CH	Código
DFL-850_12-SEP-1997.txt	MINISTERIO DE OBRAS PÚBLICAS	MINOP	1997	CH	Estatutos
DFL-88_01-JUN-1953.txt	ADOPTA LAS MEDIDAS QUE INDICA EN RELACION CON EL MINISTERIO DE ECONOMIA Y COMERCIO Y SUS ATRIBUCIONES Y ACTIVIDADES	MINH	1953	CH	Estatutos
DL-1224_08-NOV-1975.txt	CREA EL SERVICIO NACIONAL DE TURISMO	MINECON	1975	CH	Estatutos
DL-1305_19-FEB-1976.txt	REESTRUCTURA Y REGIONALIZA EL MINISTERIO DE LA VIVIENDA Y URBANISMO	MINVU	1975	CH	Estatutos
DL-1808_25-JUN-1977.txt	APRUEBA CONVENIO INTERNACIONAL SOBRE RESPONSABILIDAD CIVIL POR DAÑOS CAUSADOS POR LA CONTAMINACION DE LAS AGUAS DEL MAR POR HIDROCARBUROS, CON SU ANEXO, DE 1969	MINRE	1977	INT	Regulación
DL-1809_25-JUN-1977.txt	APRUEBA CONVENIO SOBRE LA PREVENCION DE LA CONTAMINACION DEL MAR POR VERTIMIENTO DE DESECHOS Y OTRAS MATERIAS, DEL AÑO 1972	MINRE	1977	INT	Regulación
DL-1939_10-NOV-1977.txt	NORMAS SOBRE ADQUISICION, ADMINISTRACION Y DISPOSICION DE BIENES DEL ESTADO	MINBN	1977	CH	Regulación
DL-2222_31-MAY-1978.txt	SUSTITUYE LEY DE NAVEGACION	MINDN	1978	CH	Regulación
DL-2442_29-DIC-1978.txt	ESTABLECE FUNCIONES Y ATRIBUCIONES DEL MINISTERIO DE ECONOMIA, FOMENTO Y RECONSTRUCCION, EN MATERIA DE PESCA ORGANIZA LA SUBSECRETARIA DE PESCA CREA EL CONSEJO NACIONAL DE PESCA Y EL SERVICIO NACIONAL DE PESCA	MINECON	1978	CH	Estatutos
DL-2700_27-JUN-1979.txt	APRUEBA LA CONVENCION INTERNACIONAL PARA LA REGULACION DE LA CAZA DE LA BALLENA	MINRE	1979	INT	Regulación
DL-3056_16-ENE-1980.txt	APRUEBA CONVENCION PARA LA PROTECCION DEL PATRIMONIO MUNDIAL CULTURAL Y NATURAL	MINRE	1979	INT	Regulación
DL-3274_05-JUN-1980.txt	FIJA LEY ORGANICA DEL MINISTERIO DE BIENES NACIONALES	MINBN	1980	CH	Estatutos
DL-3485_27-SEP-1980.txt	APRUEBA CONVENCION RELATIVA A LAS ZONAS HUMEDAS DE IMPORTANCIA INTERNACIONAL, ESPECIALMENTE COMO HABITAT DE LAS AVES ACUATICAS	MINRE	1980	INT	Regulación
DL-3516_01-DIC-1980.txt	ESTABLECE NORMAS SOBRE DIVISIÓN DE PREDIOS RÚSTICOS	MINAG	1980	CH	Regulación
DL-574_11-OCT-1974.txt	FIJA EL TEXTO REFUNDIDO DEL DECRETO CON FUERZA DE LEY 336, DE 1953, DE LA LEY 17.699 Y DE LAS DISPOSICIONES LEGALES REFERENTES A LA ADMINISTRACION, TUICION Y DISPOSICION DE BIENES DEL ESTADO	MINBN	1974	CH	Regulación
DL-873_28-ENE-1975.txt	APRUEBA CONVENCION SOBRE EL COMERCIO INTERNACIONAL DE ESPECIES AMENAZADAS DE FAUNA Y FLORA SILVESTRES	MINRE	1975	INT	Regulación
DTO-1_18-NOV-1992.txt	REGLAMENTO PARA EL CONTROL DE LA CONTAMINACION ACUATICA	MINDN	1992	CH	Regulación
DTO-1_27-FEB-1987.txt	REGLAMENTO DEL CODIGO DE MINERIA	MINMIN	1986	CH	Regulación
DTO-107_14-ABR-1998.txt	PROMULGA EL CONVENIO INTERNACIONAL SOBRE COOPERACION, PREPARACION Y LUCHA CONTRA LA CONTAMINACION POR HIDROCARBUROS, 1990 Y SU ANEXO	MINRE	1998	INT	Regulación
DTO-114_06-AGO-2010.txt	PROMULGA LA CONVENCIÓN INTERAMERICANA PARA LA PROTECCIÓN Y CONSERVACIÓN DE LAS TORTUGAS MARINAS	MINRE	2010	INT	Regulación
DTO-12_09-MAY-2011.txt	ESTABLECE NORMA PRIMARIA DE CALIDAD AMBIENTAL PARA MATERIAL PARTICULADO FINO RESPIRABLE MP 2,5	MINMA	2011	CH	Regulación
DTO-123_13-ABR-1995.txt	PROMULGA LA CONVENCION MARCO DE LAS NACIONES UNIDAS SOBRE EL CAMBIO CLIMATICO	MINRE	1995	INT	Regulación
DTO-124_25-SEP-2009.txt	REGLAMENTA EL ARTÍCULO 34 DE LA LEY Nº19.253 A FIN DE REGULAR LA CONSULTA Y LA PARTICIPACIÓN DE LOS PUEBLOS INDÍGENAS	MINDS	2009	CH	Regulación
DTO-13_23-JUN-2011.txt	ESTABLECE NORMA DE EMISIÓN PARA CENTRALES TERMOELÉCTRICAS	MINMA	2011	CH	Regulación

DTO-134_26-MAY-2009.txt	APRUEBA REGLAMENTO DE LA LEY Nº 20.249 QUE CREA EL ESPACIO COSTERO MARINO DE LOS PUEBLOS ORIGINARIOS	MINDS	2008	CH	Regulación
DTO-1340 BIS_27-AGO-1941.txt	APRUEBA EL REGLAMENTO GENERAL DE POLICIA MARITIMA, FLUVIAL Y LACUSTRE	MINDN	1941	CH	Regulación
DTO-136_11-ABR-2012.txt	PROMULGA EL PROTOCOLO DE 1996 RELATIVO AL CONVENIO SOBRE LA PREVENCIÓN DE LA CONTAMINACIÓN DEL MAR POR VERTIMIENTO DE DESECHOS Y OTRAS MATERIAS, 1972	MINRE	2011	INT	Regulación
DTO-139_23-DIC-1998.txt	REGLAMENTO DE SISTEMA DE POSICIONAMIENTO AUTOMATICO DE NAVES PESQUERAS Y DE INVESTIGACION PESQUERA	SUBPESCA	1998	CH	Regulación
DTO-1393_18-NOV-1997.txt	PROMULGA LA CONVENCION DE LAS NACIONES UNIDAS SOBRE EL DERECHO DEL MAR Y SUS ANEXOS Y EL ACUERDO RELATIVO A LA APLICACION DE LA PARTE XI DE DICHA CONVENCION Y SU ANEXO	MINRE	1997	INT	Regulación
DTO-141_25-MAR-1975.txt	APRUEBA CONVENCION SOBRE EL COMERCIO INTERNACIONAL DE ESPECIES AMENAZADAS DE FAUNA Y FLORA SILVESTRES	MINRE	1975	INT	Regulación
DTO-148_12-JUN-2003.txt	APRUEBA REGLAMENTO SANITARIO SOBRE MANEJO DE RESIDUOS PELIGROSOS	MINSAL	2003	CH	Regulación
DTO-15_09-JUN-2011.txt	REGLAMENTO DE REGISTRO DE PERSONAS ACREDITADAS PARA ELABORAR LOS INSTRUMENTOS DE EVALUACIÓN AMBIENTAL Y SANITARIA Y LAS CERTIFICACIONES EXIGIDAS POR LA LEY GENERAL DE PESCA Y ACUICULTURA Y SUS REGLAMENTOS	SUBPESCA	2011	CH	Regulación
DTO-150_11-JUL-2005.txt	DECLARA RESERVA MARINA ESPACIO MARITIMO EN TORNO A ISLA CHAÑARAL, III REGION	SUBPESCA	2005	CH	Regulación
DTO-151_11-JUL-2005.txt	DECLARA RESERVA MARINA ESPACIO MARITIMO EN TORNO A ISLA CHOROS E ISLA DAMAS, IV REGION	SUBPESCA	2006	CH	Regulación
DTO-1513_03-MAR-1994.txt	PROMULGA EL PROTOCOLO A LA CONVENCION INTERNACIONAL PARA LA REGULACION DE LA CAZA DE BALLENAS, DE 1946	MINRE	1993	INT	Regulación
DTO-162_02-SEP-2006.txt	CREA COMITE NACIONAL CITES	MINRE	2006	INT	Regulación
DTO-1689_04-MAY-1995.txt	PROMULGA EL PROTOCOLO RELATIVO AL CONVENIO INTERNACIONAL PARA PREVENIR LA CONTAMINACION POR LOS BUQUES, DE 1973	MINRE	1994	INT	Regulación
DTO-18_21-FEB-2011.txt	ESTABLECE MEDIDAS DE APLICACIÓN DEL CONVENIO SOBRE COMERCIO INTERNACIONAL DE ESPECIES AMENAZADAS DE FAUNA Y FLORA SILVESTRES (CITES), EN FLORA NO FORESTAL	MINAG	2010	CH	Regulación
DTO-184_31-DIC-2007.txt	PROMULGA ACUERDO SOBRE LOS PRIVILEGIOS E INMUNIDADES DEL TRIBUNAL INTERNACIONAL DEL DERECHO DEL MAR	MINRE	2007	INT	Estatutos
DTO-185_16-ENE-1992.txt	REGLAMENTA FUNCIONAMIENTO DE ESTABLECIMIENTOS EMISORES DE ANHIDRIDO SULFUROSO, MATERIAL PARTICULADO Y ARSENICO EN TODO EL TERRITORIO DE LA REPUBLICA	MINMIN	1991	CH	Regulación
DTO-189_05-ENE-2008.txt	APRUEBA REGLAMENTO SOBRE CONDICIONES SANITARIAS Y DE SEGURIDAD BÁSICAS EN LOS RELLENOS SANITARIOS	MINSAL	2005	CH	Regulación
DTO-1963_06-MAY-1995.txt	PROMULGA EL CONVENIO SOBRE LA DIVERSIDAD BIOLOGICA	MINRE	1994	INT	Regulación
DTO-2_20-ABR-2006.txt	SUSTITUYE REGLAMENTO SOBRE CONCESIONES MARITIMAS, FIJADO POR DECRETO (M) Nº 660, DE 1988	MINDN	2005	CH	Regulación
DTO-2065_13-FEB-1998.txt	PROMULGA LA CONVENCION DE LAS NACIONES UNIDAS DE LUCHA CONTRA LA DESERTIFICACION EN LOS PAISES AFECTADOS POR SEQUIA GRAVE O DESERTIFICACION, EN PARTICULAR EN AFRICA	MINRE	1997	INT	Regulación
DTO-210_12-DIC-2009.txt	REGLAMENTO DE REPOBLACIÓN Y SIEMBRA DE ESPECIES HIDROBIOLÓGICAS PARA FINES DE PESCA RECREATIVA	SUBPESCA	2009	CH	Regulación
DTO-222_23-JUN-2011.txt	APRUEBA REGLAMENTO PARA APLICACIÓN DEL SISTEMA DE CLASIFICACIÓN, CALIDAD Y SEGURIDAD DE LOS PRESTADORES DE SERVICIOS TURÍSTICOS	MINECON	2011	CH	Regulación
DTO-236_14-OCT-2008.txt	PROMULGA EL CONVENIO Nº 169 SOBRE PUEBLOS INDÍGENAS Y TRIBALES EN PAÍSES INDEPENDIENTES DE LA ORGANIZACIÓN INTERNACIONAL DEL TRABAJO	MINRE	2008	INT	Convenio
DTO-238_04-AGO-2005.txt	REGLAMENTO SOBRE PARQUES MARINOS Y RESERVAS MARINAS DE LA LEY GENERAL DE PESCA Y ACUICULTURA	SUBPESCA	2004	CH	Regulación
DTO-248_16-OCT-2004.txt	APRUEBA REGLAMENTO SOBRE RECONOCIMIENTO DE NAVES Y ARTEFACTOS NAVALES	MINDN	2004	CH	Regulación
DTO-248_27-ENE-2012.txt	APRUEBA REGLAMENTO ORGÁNICO Y DE FUNCIONAMIENTO DEL MINISTERIO DE DEFENSA NACIONAL	MINDN	2010	CH	Estatutos
DTO-25_20-OCT-2011.txt	APRUEBA REGLAMENTO DEL CONSEJO CONSULTIVO DEL MINISTERIO DEL MEDIO AMBIENTE Y LOS CONSEJOS CONSULTIVOS REGIONALES DEL MEDIO AMBIENTE	MINMA	2011	CH	Estatutos
DTO-258_16-ENE-2009.txt	PROMULGA EL ANEXO V (FACULTATIVO) DEL CONVENIO INTERNACIONAL PARA PREVENIR LA CONTAMINACIÓN POR LOS BUQUES, 1973, MODIFICADO POR EL PROTOCOLO DE 1978, Y SUS ENMIENDAS	MINRE	2008	INT	Regulación
DTO-259_12-MAY-1980.txt	PROMULGA LA CONVENCION SOBRE LA PROTECCION DEL PATRIMONIO MUNDIAL, CULTURAL Y NATURAL, SUSCRITA EN UNESCO, PARIS, EL 16 DE NOVIEMBRE DE 1972	MINRE	1980	INT	Regulación
DTO-263_24-FEB-1986.txt	APRUEBA REGLAMENTO DE SANIDAD MARITIMA, AEREA Y DE LAS FRONTERAS	MINSAL	1985	CH	Regulación
DTO-272_27-DIC-2005.txt	PROMULGA EL ACUERDO SOBRE LA CONSERVACION DE ALBATROS Y PETRELES Y SU ANEXOS	MINRE	2005	INT	Regulación
DTO-286_14-DIC-1984.txt	APRUEBA REGLAMENTO SOBRE NIVELES MAXIMOS PERMISIBLES DE RUIDOS MOLESTOS GENERADOS POR FUENTES FIJAS	MINSAL	1984	CH	Regulación
DTO-29_27-ABR-2012.txt	APRUEBA REGLAMENTO PARA LA CLASIFICACIÓN DE ESPECIES SILVESTRES SEGÚN ESTADO DE CONSERVACIÓN	MINMA	2011	CH	Regulación
DTO-290_26-JUL-1993.txt	REGLAMENTO DE CONCESIONES Y AUTORIZACIONES DE ACUICULTURA	MINECON	1993	CH	Regulación
DTO-2932_14-DIC-2009.txt	PROMULGA PLAN REGULADOR	MUNI_FREIRINA	2009	REG	Regulación
DTO-295_19-JUN-1986.txt	PROMULGA EL PROTOCOLO PARA LA PROTECCION DEL PACIFICO SUDESTE CONTRA LA CONTAMINACION PROVENIENTE DE FUENTES TERRESTRES Y SUS ANEXOS	MINRE	1986	INT	Regulación
DTO-296_14-JUN-1986.txt	PROMULGA EL CONVENIO PARA LA PROTECCION DEL MEDIO AMBIENTE Y LA ZONA COSTERA DEL PACIFICO SUDESTE	MINRE	1986	INT	Regulación
DTO-297_31-JUL-2006.txt	REGLAMENTO PARA LA INSTALACION DE COLECTORES	SUBPESCA	2005	CH	Regulación
DTO-3_01-DIC-2011.txt	APRUEBA REGLAMENTO ORGÁNICO MINISTERIO DEL MEDIO AMBIENTE	MINMA	2011	CH	Estatutos
DTO-30_03-ABR-1997.txt	REGLAMENTO DEL SISTEMA DE EVALUACION DE IMPACTO AMBIENTAL	MINSGP	1997	CH	Regulación
DTO-301_14-DIC-1984.txt	APRUEBA REGLAMENTO SOBRE CONDICIONES SANITARIAS MINIMAS DE LOS CAMPINGS O CAMPAMENTOS DE TURISMO	MINSAL	1984	CH	Regulación
DTO-314_06-JUL-2005.txt	REGLAMENTO DE ACTIVIDADES DE ACUICULTURA EN AREAS DE MANEJO Y EXPLOTACION DE RECURSOS BENTONICOS	SUBPESCA	2004	CH	Regulación

DTO-320_14-DIC-2001.txt	REGLAMENTO AMBIENTAL PARA LA ACUICULTURA	SUBPESCA	2001	CH	Regulación
DTO-327_10-SEP-1998.txt	FIJA REGLAMENTO DE LA LEY GENERAL DE SERVICIOS ELECTRICOS	MINMIN	1997	CH	Regulación
DTO-336_12-ABR-2006.txt	CREA COMISION DEL PROGRAMA PAIS DE EFICIENCIA ENERGETICA	MINECON	2005	CH	Estatutos
DTO-345_14-DIC-2006.txt	APRUEBA REGLAMENTO SOBRE PLAGAS HIDROBIOLOGICAS	SUBPESCA	2005	CH	Regulación
DTO-349_16-FEB-2005.txt	PROMULGA EL PROTOCOLO DE KYOTO DE LA CONVENCION MARCO DE LAS NACIONES UNIDAS SOBRE EL CAMBIO CLIMATICO Y SUS ANEXOS A Y B	MINRE	2004	INT	Regulación
DTO-355_26-AGO-1995.txt	REGLAMENTO SOBRE AREAS DE MANEJO Y EXPLOTACION DE RECURSOS BENTONICOS	SUBPESCA	1995	CH	Regulación
DTO-358_03-JUN-1995.txt	PROMULGA EL CONVENIO INTERNACIONAL RELATIVO A LA INTERVENCION EN ALTA MAR EN CASOS DE ACCIDENTES QUE CAUSEN UNA CONTAMINACION POR HIDROCARBUROS, DE 1969, Y EL PROTOCOLO RELATIVO A LA INTERVENCION EN ALTA MAR EN CASOS DE CONTAMINACION POR SUSTANCIAS DISTINTAS DE LOS HIDROCARBUROS, DE 1973	MINRE	1995	INT	Regulación
DTO-358_10-JUL-2006.txt	APRUEBA REGLAMENTO DEL REGISTRO NACIONAL PESQUERO INDUSTRIAL. DEJA SIN EFECTO DECRETOS QUE INDICA	SUBPESCA	2005	CH	Regulación
DTO-38_07-MAY-2012.txt	REGLAMENTO GENERAL DE OBSERVACIÓN DE MAMÍFEROS, REPTILES Y AVES HIDROBIOLÓGICAS Y DEL REGISTRO DE AVISTAMIENTO DE CETÁCEOS	SUBPESCA	2011	CH	Regulación
DTO-383_29-AGO-2009.txt	APRUEBA REGLAMENTO QUE FIJA LOS NIVELES MÍNIMOS DE OPERACIÓN POR ESPECIE Y ÁREA DE LAS CONCESIONES Y AUTORIZACIONES DE ACUICULTURA	SUBPESCA	2010	CH	Regulación
DTO-388_02-DIC-1995.txt	REGLAMENTO DE SUSTITUCION DE EMBARCACIONES ARTESANALES Y DE REEMPLAZO DE LA INSCRIPCION DE PESCADORES EN EL REGISTRO ARTESANAL	MINECON	1995	CH	Regulación
DTO-397_22-JUL-1985.txt	APRUEBA REGLAMENTO DE PRACTICAJE Y PILOTAJE	MINDN	1985	CH	Regulación
DTO-4_27-JUN-1990.txt	CREA RESERVA NACIONAL PINGÜINO DE HUMBOLDT EN TERRENOS FISCALES DE LA III Y IV REGION Y LA DECLARA LUGAR DE INTERES CIENTIFICO	MINMIN	1990	CH	Regulación
DTO-422_11-NOV-1976.txt	APRUEBA REGLAMENTO DE LOS SERVICIOS TURISTICOS	MINECON	1976	CH	Regulación
DTO-425_11-AGO-1986.txt	PROMULGA EL ACUERDO SOBRE LA COOPERACION REGIONAL PARA EL COMBATE CONTRA LA CONTAMINACION DEL PACIFICO SUDESTE POR HIDROCARBUROS Y OTRAS SUSTANCIAS NOCIVAS EN CASOS DE EMERGENCIA, SUSCRITO EN LIMA, EL 12 DE NOVIEMBRE DE 1981	MINRE	1986	INT	Regulación
DTO-430_21-ENE-1992.txt	FIJA EL TEXTO REFUNDIDO, COORDINADO Y SISTEMATIZADO DE LA LEY N° 18.892, DE 1989 Y SUS MODIFICACIONES, LEY GENERAL DE PESCA Y ACUICULTURA	MINECON	1991	CH	Regulación
DTO-4363_31-JUL-1931.txt	APRUEBA TEXTO DEFINITIVO DE LA LEY DE BOSQUES	MINBN	1931	CH	Regulación
DTO-455_29-OCT-1992.txt	REGLAMENTA DESIGNACION DE INTEGRANTES DEL CONSEJO DE INVESTIGACION PESQUERA	SUBPESCA	1992	CH	Estatutos
DTO-456_16-NOV-1992.txt	REGLAMENTO DEL FONDO DE FOMENTO PARA LA PESCA ARTESANAL	MINECON	1992	CH	Regulación
DTO-458; DFL-458_13-ABR-1976.txt	APRUEBA NUEVA LEY GENERAL DE URBANISMO Y CONSTRUCCIONES	MINVU	1975	CH	Regulación
DTO-46_17-ENE-2003.txt	ESTABLECE NORMA DE EMISION DE RESIDUOS LIQUIDOS A AGUAS SUBTERRANEAS	MINSGP	2002	CH	Regulación
DTO-461_03-NOV-1995.txt	ESTABLECE REQUISITOS QUE DEBEN CUMPLIR LAS SOLICITUDES SOBRE PESCA DE INVESTIGACION	SUBPESCA	1995	CH	Regulación
DTO-466_29-MAY-1996.txt	CREA COMITE NACIONAL ASESOR SOBRE CAMBIO GLOBAL	MINRE	1995	INT	Estatutos
DTO-47_16-ABR-1992.txt	FIJA NUEVO TEXTO DE LA ORDENANZA GENERAL DE LA LEY GENERAL DE URBANISMO Y CONSTRUCCIONES	MINVU	1992	CH	Regulación
DTO-475_08-OCT-1977.txt	PROMULGA EL CONVENIO INTERNACIONAL SOBRE RESPONSABILIDAD CIVIL POR DAÑOS CAUSADOS POR LA CONTAMINACION DE LAS AGUAS DEL MAR POR HIDROCARBUROS CON SU ANEXO DEL AÑO 1969	MINRE	1977	INT	Regulación
DTO-475_11-ENE-1995.txt	ESTABLECE POLITICA NACIONAL DE USO DEL BORDE COSTERO DEL LITORAL DE LA REPUBLICA, Y CREA COMISION NACIONAL QUE INDICA	MINDN	1994	CH	Politica
DTO-476_11-OCT-1977.txt	PROMULGA EL CONVENIO SOBRE PREVENCION DE LA CONTAMINACION DEL MAR POR VERTIMIENTO DE DESECHOS Y OTRAS MATERIAS, CON SUS ANEXOS I, II Y III, DEL AÑO 1972	MINRE	1977	INT	Regulación
DTO-484_02-ABR-1991.txt	REGLAMENTO DE LA LEY N° 17.288, SOBRE EXCAVACIONES Y/O PROSPECCIONES ARQUEOLOGICAS, ANTROPOLOGICAS Y PALEONTOLOGICAS	MINEDUC	1990	CH	Regulación
DTO-489_21-SEP-1979.txt	APRUEBA CONVENCION INTERNACIONAL PARA LA REGULACION DE LA CAZA DE BALLENAS Y SU ANEXO	MINRE	1979	INT	Regulación
DTO-49_02-SEP-2006.txt	REGLAMENTO DE VIVEROS Y CENTROS DE MATANZA	SUBPESCA	2006	CH	Regulación
DTO-499_15-NOV-1994.txt	REGLAMENTO DEL REGISTRO NACIONAL DE ACUICULTURA	MINECON	1994	CH	Regulación
DTO-5_07-DIC-1998.txt	APRUEBA REGLAMENTO DE LA LEY DE CAZA	MINAG	1998	CH	Regulación
DTO-50_28-ABR-2012.txt	APRUEBA REGLAMENTO QUE FIJA PROCEDIMIENTO PARA OTORGAMIENTO DE CONCESIONES TURÍSTICAS EN ÁREAS SILVESTRES PROTEGIDAS DEL ESTADO	MINECON	2011	CH	Regulación
DTO-518_06-ABR-2006.txt	DECLARA AREAS DE USOS PREFERENTES ESPECIFICOS LOS ESPACIOS DEL BORDE COSTERO DEL LITORAL DE LA IV REGION DE COQUIMBO	MINDN	2005	CH	Regulación
DTO-531_04-OCT-1967.txt	CONVENCION PARA LA PROTECCION DE LA FLORA, LA FAUNA Y LAS BELLEZAS ESCENICAS NATURALES DE AMERICA	MINRE	1967	INT	Regulación
DTO-539_02-DIC-1995.txt	REGLAMENTA APAREJOS PROPIOS DE LA PESCA DEPORTIVA	SUBPESCA	1995	CH	Regulación
DTO-545_30-ABR-1996.txt	REGLAMENTA OTORGAMIENTO DE LICENCIAS PARA REALIZAR PESCA DEPORTIVA	SUBPESCA	1995	CH	Regulación
DTO-550_11-MAR-1993.txt	REGLAMENTO SOBRE LIMITACIONES A LAS AREAS DE CONCESIONES O AUTORIZACIONES DE ACUICULTURA	MINECON	1992	CH	Regulación
DTO-604_13-ENE-1995.txt	MODIFICA REGLAMENTO DE CONCESIONES Y AUTORIZACIONES DE ACUICULTURA	SUBPESCA	2012	CH	Regulación
DTO-609_07-MAY-1998.txt	ESTABLECE NORMA DE EMISION PARA LA REGULACION DE CONTAMINANTES ASOCIADOS A LAS DESCARGAS DE RESIDUOS INDUSTRIALES LIQUIDOS A SISTEMAS DE ALCANTARILLADO	MINOP	1998	CH	Regulación
DTO-626 EXENTO_28-SEP-2001.txt	APRUEBA REGLAMENTO DE CERTIFICACION Y OTROS REQUISITOS SANITARIOS PARA LA IMPORTACION DE ESPECIES HIDROBIOLOGICAS	SUBPESCA	2001	CH	Regulación

DTO-635_17-FEB-1992.txt	CREA REGISTRO NACIONAL DE PESCADORES ARTESANALES	SUBPESCA	1991	CH	Regulación
DTO-656_24-NOV-1986.txt	PROMULGA PROTOCOLO COMPLEMENTARIO DEL ACUERDO SOBRE LA COOPERACION REGIONAL PARA EL COMBATE CONTRA LA CONTAMINACION DEL PACIFICO SUDESTE POR HIDROCARBUROS Y OTRAS SUSTANCIAS NOCIVAS	MINRE	1986	INT	Regulación
DTO-685_13-OCT-1992.txt	PROMULGA EL CONVENIO DE BASILEA SOBRE EL CONTROL DE LOS MOVIMIENTOS TRANSFRONTERIZOS DE LOS DESECHOS PELIGROSOS Y SU ELIMINACION	MINRE	1992	INT	Regulación
DTO-72_24-MAR-2012.txt	APRUEBA REGLAMENTO DE CERTIFICACIÓN Y OTROS REQUISITOS SANITARIOS PARA LA IMPORTACIÓN DE ESPECIES HIDROBIOLÓGICAS	SUBPESCA	2011	CH	Regulación
DTO-720_17-AGO-1995.txt	PROMULGA EL PROTOCOLO PARA LA PROTECCION DEL PACIFICO SUDESTE CONTRA LA CONTAMINACION RADIACTIVA	MINRE	1995	INT	Regulación
DTO-730_04-MAY-1996.txt	APRUEBA REGLAMENTO DE INTERNACION DE ESPECIES DE PRIMERA IMPORTACION	SUBPESCA	1995	CH	Regulación
DTO-752_10-NOV-1982.txt	APRUEBA EL REGLAMENTO DE BUCEO PARA BUZOS PROFESIONALES	MINDN	1982	CH	Regulación
DTO-771_11-NOV-1981.txt	PROMULGA LA CONVENCION SOBRE ZONAS HUMEDAS DE IMPORTANCIA INTERNACIONAL ESPECIALMENTE COMO HABITAT DE LAS AVES ACUATICAS, SUSCRITO EN IRAN EL 2 DE FEBRERO DE 1971	MINRE	1981	INT	Regulación
DTO-82_11-FEB-2011.txt	APRUEBA REGLAMENTO DE SUELOS, AGUAS Y HUMEDALES	MINAG	2010	CH	Regulación
DTO-827_31-AGO-1995.txt	PROMULGA EL PROTOCOLO PARA LA CONSERVACION Y ADMINISTRACION DE LAS AREAS MARINAS Y COSTERAS PROTEGIDAS DEL PACIFICO SUDESTE	MINRE	1995	INT	Regulación
DTO-83_22-JUN-2005.txt	PROMULGA ENMIENDAS AL ANEXO DEL PROTOCOLO DE 1978 RELATIVO AL CONVENIO INTERNACIONAL PARA PREVENIR LA CONTAMINACION POR LOS BUQUES, MARPOL 1973, ADOPTADAS POR EL COMITE DE PROTECCION DEL MEDIO MARINO DE LA ORGANIZACION MARITIMA INTERNACIONAL	MINRE	2005	INT	Regulación
DTO-868_12-DIC-1981.txt	PROMULGA EL CONVENIO SOBRE LA CONSERVACION DE ESPECIES MIGRATORIAS DE LA FAUNA SALVAJE	MINRE	1981	INT	Regulación
DTO-87_09-JUL-1997.txt	APRUEBA REGLAMENTO GENERAL DE DEPORTES NAUTICOS Y DEROGA EL ACTUAL	MINDN	1997	CH	Regulación
DTO-88_18-ENE-2012.txt	PROMULGA ENMIENDAS AL ANEXO I DEL PROTOCOLO DE 1978 RELATIVO AL CONVENIO INTERNACIONAL PARA PREVENIR LA CONTAMINACIÓN POR LOS BUQUES, 1973	MINRE	2011	INT	Regulación
DTO-90_07-MAR-2001.txt	NORMA DE EMISION PARA LA REGULACION DE CONTAMINANTES ASOCIADOS A LAS DESCARGAS DE RESIDUOS LIQUIDOS A AGUAS MARINAS Y CONTINENTALES SUPERFICIALES	MINSGP	2000	CH	Regulación
DTO-93_05-OCT-2009.txt	REGLAMENTO GENERAL DE LA LEY SOBRE RECUPERACION DEL BOSQUE NATIVO Y FOMENTO FORESTAL	MINAG	2008	CH	Regulación
DTO-93_26-OCT-1995.txt	REGLAMENTO PARA LA DICTACION DE NORMAS DE CALIDAD AMBIENTAL Y DE EMISION	MINSGP	1995	CH	Regulación
DTO-94_26-OCT-1995.txt	REGLAMENTO QUE FIJA EL PROCEDIMIENTO Y ETAPAS PARA ESTABLECER PLANES DE PREVENCION Y DE DESCONTAMINACION	MINSGP	1995	CH	Regulación
DTO-95_07-DIC-2002.txt	MODIFICA REGLAMENTO DEL SISTEMA DE EVALUACION DE IMPACTO AMBIENTAL	MINSGP	2001	CH	Regulación
ENBIODIVERSIDAD.txt	ESTRATEGIA NACIONAL DE BIODIVERSIDAD Y PLAN DE ACCION	MINMA	2005	CH	Estrategia nacional
ENHUMEDALES.txt	ESTRATEGIA NACIONAL PARA LA CONSERVACION Y USO RACIONAL DE LOS HUMEDALES EN CHILE	MINMA	2005	CH	Estrategia nacional
ERBIODIVERSIDADIIIregion.txt	ESTRATEGIA Y PLAN DE ACCIÓN PARA LA CONSERVACIÓN Y PROTECCIÓN DE LA BIODIVERSIDAD EN ATACAMA	SEREMI_MA	2005	REG	Estrategia regional
ERBIODIVERSIDADIVregion.txt	PROPUESTA ESTRATEGIA REGIONAL Y PLAN DE ACCIÓN DE LA BIODIVERSIDAD IV REGIÓN COQUIMBO	SEREMI_MA	2005	REG	Estrategia regional
ERDIIIregion.txt	ESTABLECE ESTRATEGIA REGIONAL DE DESARROLLO COQUIMBO 2007-2017	GORE_ATACAMA	2007	REG	Estrategia regional
ERDIVregion.txt	ESTABLECE ESTRATEGIA REGIONAL DE DESARROLLO COQUIMBO 2010-2020	GORE_COQUIMBO	2010	REG	Estrategia regional
LEY-16391_14-DIC-1965.txt	CREA EL MINISTERIO DE LA VIVIENDA Y URBANISMO	MINOP	1965	CH	Estatutos
LEY-17288_27-ENE-1970.txt	LEGISLA SOBRE MONUMENTOS NACIONALES; MODIFICA LAS LEYES 16.617 Y 16.719; DEROGA EL DECRETO LEY 651, DE 17 DE OCTUBRE DE 1925	MINEDUC	1970	CH	Regulación
LEY-18248_14-OCT-1983.txt	CODIGO DE MINERIA	MINMIN	1983	CH	Regulación
LEY-18348_19-OCT-1984.txt	CREA LA CORPORACIÓN NACIONAL FORESTAL Y DE PROTECCIÓN DE RECURSOS NATURALES RENOVABLES	MINAG	1984	CH	Estatutos
LEY-18362_27-DIC-1984.txt	CREA UN SISTEMA NACIONAL DE AREAS SILVESTRES PROTEGIDAS DEL ESTADO	MINAG	1984	CH	Regulación
LEY-18378_29-DIC-1984.txt	DEROGA LA LEY N° 15.020 Y EL DECRETO CON FUERZA DE LEY N° R.R.A. 26, DE 1963, Y ESTABLECE SANCIONES QUE SEÑALA	MINAG	1984	CH	Regulación
LEY-18755_07-ENE-1989.txt	ESTABLECE NORMAS SOBRE EL SERVICIO AGRICOLA Y GANADERO	MINAG	1989	CH	Estatutos
LEY-18902_27-ENE-1990.txt	CREA LA SUPERINTENDENCIA DE SERVICIOS SANITARIOS	MINECON	1989	CH	Estatutos
LEY-18989_19-JUL-1990.txt	CREA EL MINISTERIO DE PLANIFICACION Y COOPERACION	MININ	1990	CH	Estatutos
LEY-19253_05-OCT-1993.txt	ESTABLECE NORMAS SOBRE PROTECCION, FOMENTO Y DESARROLLO DE LOS INDIGENAS, Y CREA LA CORPORACION NACIONAL DE DESARROLLO INDIGENA	MINDS	1993	CH	Estatutos
LEY-19300_09-MAR-1994.txt	APRUEBA LEY SOBRE BASES GENERALES DEL MEDIO AMBIENTE	MINSGP	1994	CH	Regulación
LEY-19473_27-SEP-1996.txt	SUSTITUYE TEXTO DE LA LEY N° 4.601, SOBRE CAZA	MINAG	1996	CH	Regulación
LEY-19525_24-OCT-1997.txt	REGULA SISTEMAS DE EVACUACION Y DRENAJE DE AGUAS LLUVIAS	MINOP	1997	CH	Regulación
LEY-20062_29-OCT-2005.txt	REGULARIZA SITUACION DE OCUPACIONES IRREGULARES EN BORDE COSTERO DE SECTORES QUE INDICA	MINBN	2005	CH	Regulación
LEY-20249_16-FEB-2008.txt	CREA EL ESPACIO COSTERO MARINO DE LOS PUEBLOS ORIGINARIOS	MINDS	2008	CH	Regulación
LEY-20256_12-ABR-2008.txt	ESTABLECE NORMAS SOBRE PESCA RECREATIVA	SUBPESCA	2008	CH	Regulación
LEY-20283_30-JUL-2008.txt	LEY SOBRE RECUPERACIÓN DEL BOSQUE NATIVO Y FOMENTO FORESTAL	MINAG	2008	CH	Regulación

LEY-20293_25-OCT-2008.txt	PROTEGE A LOS CETÁCEOS E INTRODUCE MODIFICACIONES A LA LEY Nº 18.892 GENERAL DE PESCA Y ACUICULTURA	SUBPESCA	2008	CH	Regulación
LEY-20417_26-ENE-2010.txt	CREA EL MINISTERIO, EL SERVICIO DE EVALUACIÓN AMBIENTAL Y LA SUPERINTENDENCIA DEL MEDIO AMBIENTE	MINSGP	2010	CH	Regulación
LEY-20423_12-FEB-2010.txt	DEL SISTEMA INSTITUCIONAL PARA EL DESARROLLO DEL TURISMO	MINECON	2010	CH	Politica
LEY-20560_03-ENE-2012.txt	MODIFICA REGULACIÓN DE LA PESCA DE INVESTIGACIÓN, REGULARIZA PESQUERÍAS ARTESANALES QUE INDICA, INCORPORA PLANES DE MANEJO BENTÓNICOS Y REGULA CUOTA GLOBAL DE CAPTURA	SUBPESCA	2011	CH	Regulación
LEY-20583_02-ABR-2012.txt	MODIFICA NORMAS SANITARIAS Y DE ORDENAMIENTO TERRITORIAL PARA LAS CONCESIONES DE ACUICULTURA	SUBPESCA	2012	CH	Regulación
LEY-20600_18-JUN-2012.txt	CREA LOS TRIBUNALES AMBIENTALES	MINMA	2012	CH	Regulación
LEY-4601_01-JUL-1929.txt	ESTABLECE LAS DISPOSICIONES POR QUE SE REGIRA LA CAZA EN EL TERRITORIO DE LA REPUBLICA	MINECON	1929	CH	Regulación
PLADECO_LAHIGUERA.txt	ACTUALIZACIÓN DEL PLAN DE DESARROLLO COMUNAL LA HIGUERA 2010-2013	MUNI_HIGUERA	2010	REG	Plan comunal
Plan_SERNATUR_IIIregion.txt	PLAN PARA EL DESARROLLO TURÍSTICO DE LA REGIÓN DE ATACAMA 2011-2014	SERNATUR	2011	REG	Plan regional
Plan_SERNATUR_IVregion.txt	PLAN PARA EL DESARROLLO TURÍSTICO DE LA REGIÓN DE COQUIMBO 2011-2014	SERNATUR	2011	REG	Plan regional
PLAN_TURISMO_LAHIGUERA.txt	ESTUDIO BÁSICO DIAGNÓSTICO Y PLAN DE DESARROLLO TURÍSTICO COMUNA DE LA HIGUERA	MUNI_HIGUERA	2008	REG	Plan comunal
POLITICA_ESPECIES_PROTEGIDAS.txt	POLITICA NACIONAL PARA LA PROTECCION DE ESPECIES PROTEGIDAS APROBADA POR EL CONSEJO DIRECTIVO DE CONAMA	MINMA	2005	CH	Politica
RES-1060 EXENTA_21-SEP-2011.txt	DA INICIO AL OCTAVO PROCESO DE CLASIFICACIÓN DE ESPECIES E INDICA LISTADO DE ESPECIES A CLASIFICAR	MINMA	2011	CH	Regulación
RES-14_19-DIC-2006.txt	PROMULGA PLAN REGIONAL DE DESARROLLO URBANO DE LA REGION DE COQUIMBO	GORE_COQUIMBO	2006	REG	Regulación
RES-2280 EXENTA_31-AGO-2011.txt	CONFIRMA Y MODIFICA RESOLUCIÓN Nº 3.080 EXENTA, DE 2009	SUBPESCA	2011	CH	Regulación
RES-2401 EXENTA_11-ENE-1993.txt	ESTABLECE REGLAMENTO PARA APROBACION DE BASES DE;CAMPEONATO DE PESCA DEPORTIVA Y CAZA SUBMARINA	MINECON	2011	CH	Regulación
RES-3080 EXENTA_17-SEP-2009.txt	AUTORIZA TRANSITORIAMENTE ACTIVIDAD PESQUERA INDUSTRIAL EN ÁREA DE RESERVA ARTESANAL QUE INDICA DE LA IV REGIÓN	SUBPESCA	2009	CH	Regulación
RES-3612 EXENTA_06-NOV-2009.txt	APRUEBA RESOLUCIÓN QUE FIJA LAS METODOLOGÍAS PARA ELABORAR LA CARACTERIZACIÓN PRELIMINAR DE SITIO (CPS) Y LA INFORMACIÓN AMBIENTAL (INFA)	SUBPESCA	2009	CH	Regulación
RES-5_21-AGO-2001.txt	PROMULGA PLAN REGULADOR INTERCOMUNAL DE LAS COMUNAS COSTERAS DE ATACAMA	GORE_ATACAMA	2001	REG	Regulación
ZONIFICACION_BORDE_COSTERO_IIIregion.txt	MEMORIA EXPLICATIVA ZONIFICACIÓN BORDE COSTERO REGIÓN ATACAMA	CRUBC	2011	REG	Plan regional
ZONIFICACION_BORDE_COSTERO_IVregion.txt	MEMORIA EXPLICATIVA ZONIFICACIÓN BORDE COSTERO REGIÓN COQUIMBO	CRUBC	2005	REG	Plan regional

ANEXO 3.4. List of agencies/organizations

Agency ID	**Description**
AGCI	Agencia de Cooperación Internacional
ARM	Armada de Chile
BUZ_DEP	Buceo Deportivo
CAR	Carabineros de Chile
CCLSP	Comité de Clasificación de especies
CCMINMA	Consejo Consultivo del Ministerio de Medio Ambiente
CCRMINMA	Consejo Consultivo Regional del Medio Ambiente
CEA	Comisión de Evaluación Ambiental
CEE	Comisión del Programa País de Eficiencia Energética
CFPA	Consejo de Fomento de la Pesca Artesanal
CIP	Consejo de Investigación Pesquera
CMN	Consejo de Monumentos Nacionales
CMS	Consejo de Ministros para la Sustentabilidad
CMT	Comité de Ministros del Turismo
CNE	Comisión Nacional de Energía
CNP	Consejo Nacional de Pesca
CNUBC	Comisión Nacional de Uso del Borde Costero
CONA	Comité Oceanográfico Nacional
CONADI	Corporación Nacional de Desarrollo Indígena
CONAF	Corporación Nacional Forestal
CONICYT	Comisión Nacional de Investigación Científica y Tecnológica
CONS_AMB	Consultoras ambientales
CRPR	Consejo Regional de Pesca Recreativa
CRUBC	Comisión Regional de Uso del Borde Costero
CZP	Consejo Zonal de Pesca
DGA	Dirección General de Aguas
DGAC	Dirección General de Aeronáutica Civil
DIRECTEMAR	Dirección General del Territorio Marítimo y de Marina Mercante
DIRMET	Dirección Meteorológica de Chile
DOP	Dirección Obras Portuarias
EMP_ACUIC	Empresarios acuicultura
EMP_ELEC	Empresas eléctricas
EMP_MIN	Empresas mineras
EMP_SAN	Empresas Sanitarias
EMP_TUR	Empresas Turísticas
FOSIS	Fondo de Desarrollo Social
GORE	Gobierno Regional
GORE_ATACAMA	Gobierno Regional de Atacama
GORE_COQUIMBO	Gobierno Regional de Coquimbo
IFOP	Instituto de Fomento Pesquero
INDI	Pueblos originarios
INDUST	Industrias
INFOR	Instituto Forestal
INN	Instituto Normalización Nacional
MINAG	Ministerio de Agricultura
MINBN	Ministerio de Bienes Nacionales
MINDN	Ministerio de Defensa Nacional
MINDS	Ministerio de Desarrollo Social
MINECON	Ministerio de Economía, Fomento y Turismo
MINEDUC	Ministerio de Educación
MINEN	Ministerio de Energía

MININ	Ministerio del Interior
MINMA	Ministerio de Medio Ambiente
MINMIN	Ministerio de Minería
MINOP	Ministerio de Obras Públicas
MINRE	Ministerio de Relaciones Exteriores
MINSAL	Ministerio de Salud
MINSGP	Ministerio Secretaría General de la Presidencia
MINTT	Ministerio de Transportes y Telecomunicaciones
MINVU	Ministerio de Vivienda y Urbanismo
MNHN	Museo Nacional de Historia Natural
MUNI	Municipalidades
MUNI_FREIRINA	Municipalidad de Freirina
MUNI_HIGUERA	Municipalidad de La Higuera
OIT	Organización Internacional del Trabajo
ONG	Organizaciones No gubernamentales
OSC	Organizaciones Sociedad Civil
PESC_ART	Pescadores Artesanales
PESC_DEP	Pescadores Deportivos
PESC_IND	Pescadores Industriales
PROP_FOR	Propietarios forestales
PROP_TI	Propietarios de Tierras
REP_EMPR	Representantes Empresas
REP_TRAB	Representantes Sindicatos Trabajadores
SAG	Servicio Agrícola Ganadero
SBAP	Servicio de Biodiversidad y Áreas Protegidas
SEA	Servicio de Evaluación Ambiental
SEC	Superintendencia de Electricidad y Combustibles
SEREMI_AG	Secretaría Regional Ministerial de Agricultura
SEREMI_BN	Secretaría Regional Ministerial de Bienes Nacionales
SEREMI_ECON	Secretaría Regional Ministerial de Economía
SEREMI_MA	Secretaría Regional Ministerial de Medio Ambiente
SEREMI_SAL	Secretaría Regional Ministerial de Salud
SEREMI_VU	Secretaría Regional Ministerial de Vivienda y Urbanismo
SERNAPESCA	Servicio Nacional de Pesca
SERNATUR	Servicio Nacional de Turismo
SHOA	Servicio Hidrográfico y Oceanográfico de la Armada
SMA	Superintendencia del Medio Ambiente
SNA	Servicio Nacional de Aduanas
SSAL	Servicio de Salud
SSS	Superintendencia de Servicios Sanitarios
SUBBN	Subsecretaría de Bienes Nacionales
SUBDEF	Subsecretaría de Defensa
SUBDERE	Subsecretaria de Desarrollo Regional y Administrativo
SUBFA	Subsecretaría para las Fuerzas Armadas
SUBMMA	Subsecretaría del Medio Ambiente
SUBPESCA	Subsecretaría de Pesca
TA	Tribunales Ambientales
UNIV	Universidades

ANEXO 3.5. Matrix of legislation co-occurrence data

Each cell contains the number of sections of documents in which each dyad of terms co-occurs. Blue cells indicate relationships modeled for the ecosystem that are accounted for in one or more section of legislation. Red cells indicate modeled relationships that are not explicitly accounted for in any section of documents. Gray diagonal cells contain the number of documents sections in which each individual term occurs. MEABRs= management and exploitation areas for benthic resources.

	flagship species habitat	kelp	wildlife watching	beaches	diving areas	research	fishing grounds	dunes	renewables energies	illegal fishing	trawling	maritime traffic	marine pollution	power plants	invasive species	climate change	dumps	coastal residential development	artisanal fishing	industrial fishing	kelp harvesting	recreational diving	MEABRs	aquaculture	tourism in MPAs	ports	MPAs	terrestrial reserves	ecotourism	restocking
flagship species habitat	110	2	2	0	0	4	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Kelp	---	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
wildlife watching	---	---	240	16	0	11	0	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	17	0
Beaches	---	---	---	498	0	1	0	14	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	9	0	10	1	4	8	0
diving areas	---	---	---	---	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Research	---	---	---	---	---	679	0	0	0	0	0	1	10	0	0	5	0	0	3	0	0	0	1	20	0	17	0	1	0	3
fishing grounds	---	---	---	---	---	---	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
Dunes	---	---	---	---	---	---	---	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0
renewables energies	---	---	---	---	---	---	---	---	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
illegal fishing	---	---	---	---	---	---	---	---	---	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trawling	---	---	---	---	---	---	---	---	---	---	59	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
maritime traffic	---	---	---	---	---	---	---	---	---	---	---	11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
marine pollution	---	---	---	---	---	---	---	---	---	---	---	---	704	1	0	0	0	0	0	0	0	0	0	1	0	3	0	0	3	1
power plants	---	---	---	---	---	---	---	---	---	---	---	---	---	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
invasive species	---	---	---	---	---	---	---	---	---	---	---	---	---	---	82	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
climate change	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dumps	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	22	0	0	0	0	0	0	0	0	0	0	0	1	0
coastal residential development	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	0	0	0	0	0	0	0	0	0	0
artisanal fishing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	329	0	3	0	28	55	0	2	0	0	0	4
industrial fishing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	12	0	0	0	0	0	0	0	0	0	0
kelp harvesting	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6	0	0	0	0	0	0	0	0	0
recreational diving	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7	0	0	0	0	0	0	0	0
MEABRs	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	158	37	0	0	0	0	0	0
Aquaculture	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	933	0	5	2	0	0	2
tourism in MPAs	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	79	1	0	0	1	0
Ports	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	680	1	0	0	0
MPAs	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	42	9	0	0
terrestrial reserves	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	101	0	0
Ecotourism	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	183	0
Restocking	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	173

ANEXO 3.6. Additional results based on MINOE software

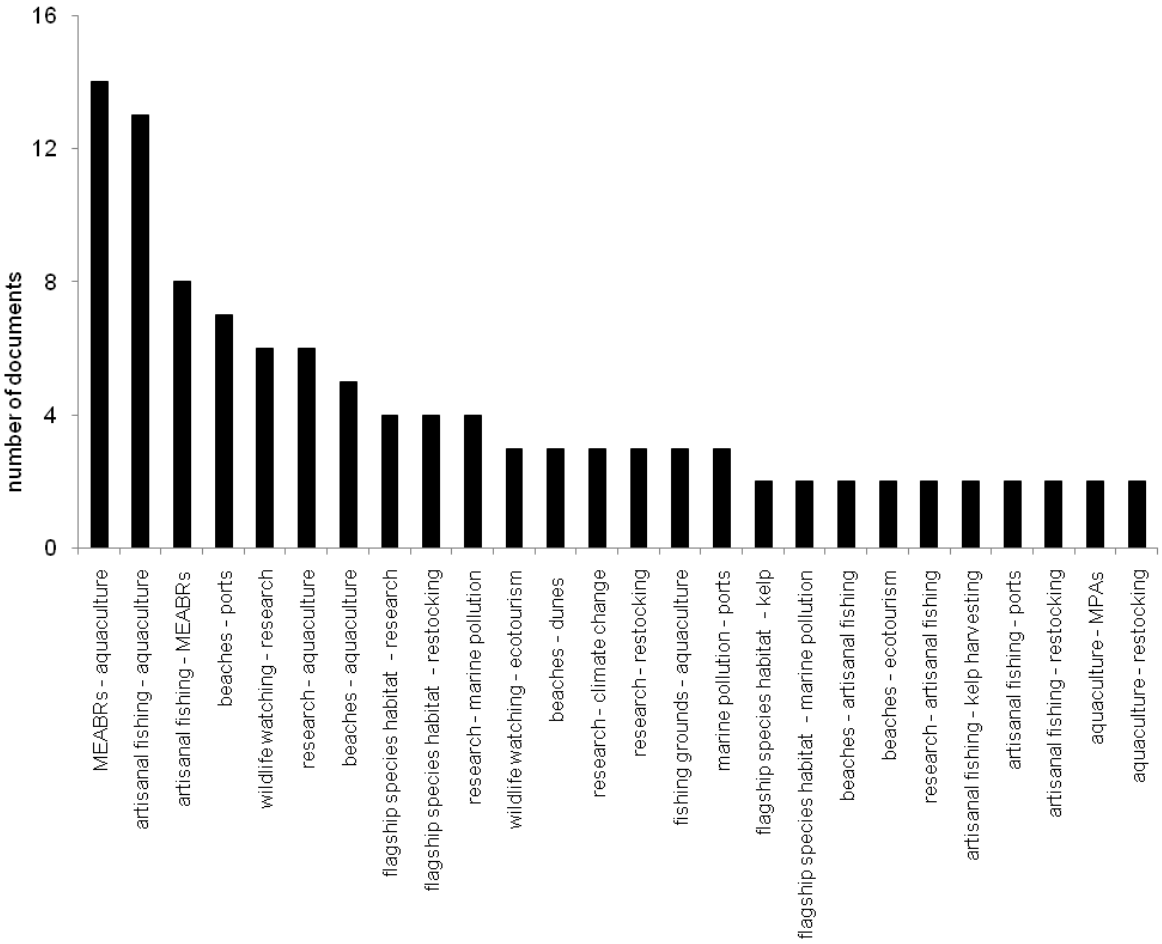

Fig. 1. Number of documents of ecosystem component dyads that account for the modeled relationships. MEABRs= management and exploitation areas for benthic resources.

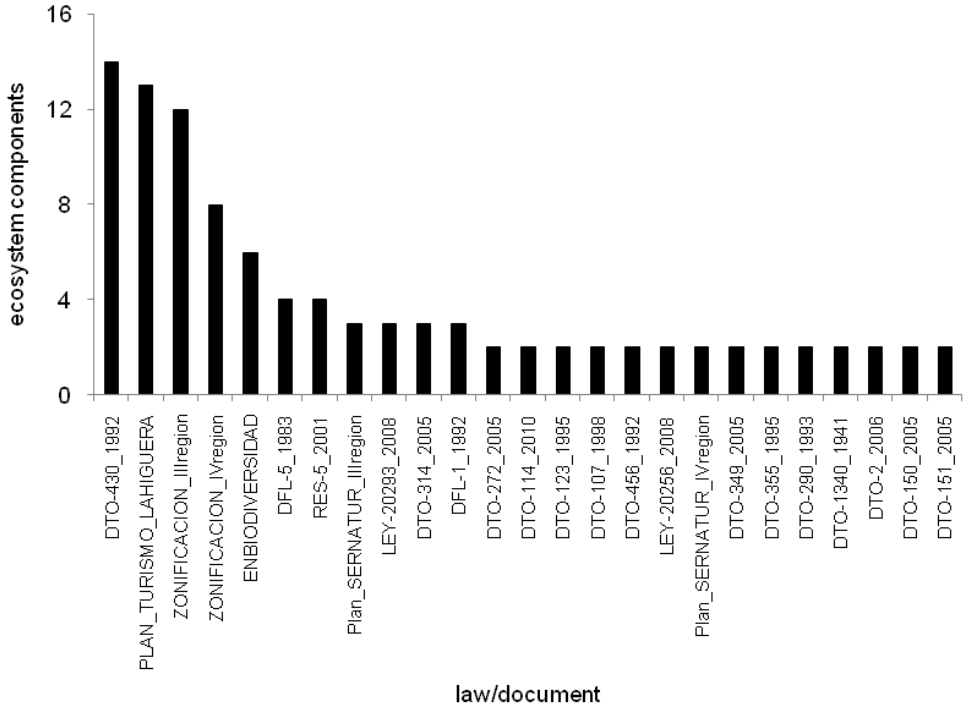

Fig. 2. Ranking of documents that account for links between different ecosystem components.

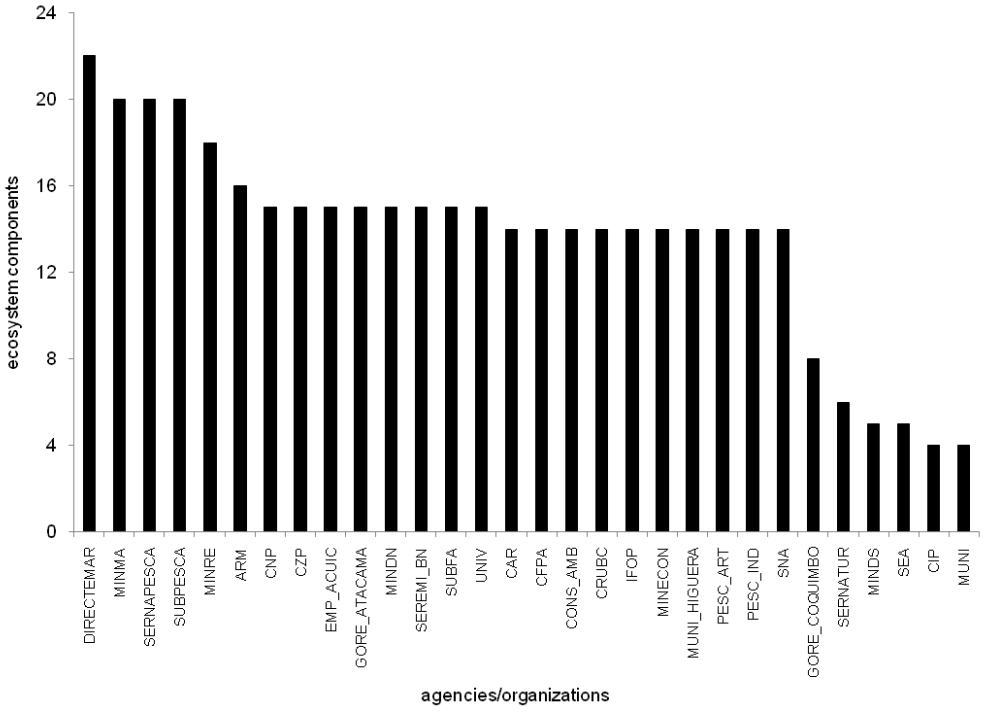

Fig. 3. Ranking of agencies (associated with documents) that account for links between different ecosystem components.

ANEXO 4.1. List of surveyed stakeholders, stakeholders named in social networks, and key stakeholders in MU-CMPA planning

Organization name	ID
CHAÑARAL DE ACEITUNO FISHERMEN´S UNION	AFOR_1
LA HIGUERA FISHERMEN´S FEDERATION	AFOR_10
CRUZ DE CHUNGUNGO FISHERMEN´S UNION	AFOR_11
CALETA HORNOS FISHERMEN´S UNION	AFOR_12
CALETA HORNOS FISHERMEN´S GROUPING	AFOR_13
LOS CHOROS FISHING COOPERATIVE	AFOR_2
LOS CHOROS FISHERMEN'S TRADE ASSOCIATION	AFOR_3
PUNTA DE CHOROS FISHERMEN´S TRADE ASSOCIATION	AFOR_4
CHUNGUNGO FISHERMEN'S TRADE ASSOCIATION	AFOR_5
CALETA CHUNGUNGO FISHERMEN´S UNION	AFOR_6
LO CASTILLO COMMUNITY ORGANIZATION	AFOR_7
TOTORALILLO NORTE FISHERMEN´S UNION	AFOR_8
CALETA HORNOS FISHERMEN´S TRADE ASSOCIATION	AFOR_9
PUNTA DE CHOROS NEIGHBORHOOD ASSOCIATION	CSO_1
LOS CHOROS NEIGHBORHOOD ASSOCIATION	CSO_2
CHAÑARAL DE ACEITUNO NEIGHBORHOOD ASSOCIATION	CSO_3
UNDERWATER SPORTS ASSOCIATION OF COQUIMBO	DOR
SCHOOLS	EDUC_1
INDUSTRIAL FISHERMEN ORGANIZATION	IFOR
LAND OWNER	LAND_OWN_1
LOS CHOROS AGRICULTURAL COMMUNITY	LAND_OWN_2
MUNICIPALITY OF FREIRINA	LOG_1
MUNICIPALITY OF LA HIGUERA	LOG_2
ARTISANAL FISHERIES PROMOTION FUND	NAG_FUND_4
FISHERIES ADMINISTRATION FUND	NAG_FUND_5
SOCIAL INVESTMENT AND SOLIDARITY FUND III REGION	NAG_FUND_III_1
ECONOMIC DEVELOPMENT AGENCY III REGION	NAG_FUND_III_2
TECHNICAL COOPERATION SERVICE III REGION	NAG_FUND_III_3
SOCIAL INVESTMENT AND SOLIDARITY FUND IV REGION	NAG_FUND_IV_1
ECONOMIC DEVELOPMENT AGENCY IV REGION	NAG_FUND_IV_2
TECHNICAL COOPERATION SERVICE IV REGION	NAG_FUND_IV_3
REGIONAL UNDERSECRETARY OF ENVIRONMENT III REGION	NAG_III_1
REGIONAL UNDERSECRETARY OF NATIONAL ASSETS III REGION	NAG_III_10
NATIONAL FISHERIES SERVICE III REGION	NAG_III_2
NATIONAL FORESTRY CORPORATION III REGION	NAG_III_3
NATIONAL TOURISM SERVICE III REGION	NAG_III_4
DIRECTION OF MARITIME TERRITORY AND MERCHANT NAVY III REGION	NAG_III_5
AGRICULTURE AND LIVESTOCK SERVICE IV REGION	NAG_III_6
DIRECTION OF PORT WORKS III REGION	NAG_III_7
ENVIRONMENTAL ASSESMENT SERVICE III REGION	NAG_III_8

NATIONAL SERVICE OF TRAINING AND EMPLOYMENT III REGION	NAG_III_9
REGIONAL UNDERSECRETARY OF ENVIRONMENT IV REGION	NAG_IV_1
REGIONAL UNDERSECRETARY OF NATIONAL ASSETS IV REGION	NAG_IV_10
REGIONAL UNDERSECRETARY OF ECONOMY IV REGION	NAG_IV_11
MINISTRY OF HOUSING AND URBANISM IV REGION	NAG_IV_12
NATIONAL FISHERIES SERVICE IV REGION	NAG_IV_2
NATIONAL FORESTRY CORPORATION IV REGION	NAG_IV_3
NATIONAL TOURISM SERVICE IV REGION	NAG_IV_4
DIRECTION OF MARITIME TERRITORY AND MERCHANT NAVY IV REGION	NAG_IV_5
AGRICULTURE AND LIVESTOCK SERVICE III REGION	NAG_IV_6
DIRECTION OF PORT WORKS IV REGION	NAG_IV_7
ENVIRONMENTAL ASSESMENT SERVICE IV REGION	NAG_IV_8
NATIONAL SERVICE OF TRAINING AND EMPLOYMENT IV REGION	NAG_IV_9
LA HIGUERA ENVIRONMENTAL DEFENCE MOVEMENT	NGO_1
OCEANA NGO	NGO_2
LEVIATHAN NGO	NGO_3
SPHENISCO NGO	NGO_4
PARTICIPACORPORATION	NGO_5
ISLAND CONSERVATION NGO	NGO_6
PLANETA VIVO NGO	NGO_7
EUTROPIA NGO	NGO_8
SEA SHEPPERD CONSERVATION SOCIETY	NGO_9
NATIONAL POLICE	POLICE_1
ADVISORY COUNCIL OF PINGÜINO HUMBOLDT NATIONAL RESERVE	PPC_1
MARINE RESERVE ADVISORY BOARD	PPC_2
REGIONAL COMMITTEE FOR FISHERIES AND AQUACULTURE	PPC_3
STRATEGIC COUNCIL FOR ARTISANAL FISHERIES	PPC_4
REGIONAL GOVERNMENT III REGION	REG_III_1
FISHERIES ZONAL COUNCIL	REG_III_IV
REGIONAL GOVERNMENT IV REGION	REG_IV_1
REGIONAL COMMISSION OF COASTAL BORDER USE IV REGION	REG_IV_2
FISHERIES DEVELOPMENT INSTITUTE	RES_1
CENTER FOR ADVANCED STUDIES IN ARID ZONES	RES_2
UNIVERSITY OF LA SERENA	RES_3
CATOLICA DEL NORTE UNIVERSITY	RES_5
ANDRES BELLO UNIVERSITY	RES_7
INACAP TECHNOLOGICAL UNIVERSITY	RES_8
ABIMAR TECHNICAL CONSULTANT	TCO_1
CYCLOS TECHNICAL CONSULTANT	TCO_2
PROMAR TECHNICAL CONSULTANT	TCO_3
CHAÑARAL DE ACEITUNO TOURISM ASSOCIATION	TOUR_III
DIVING CENTERS	TOUR_IV_2
PUNTA DE CHOROS TOURISM ENTERPRISES	TOUR_IV_3
GASTRONOMIC ENTERPRISES	TOUR_IV_4

ANEXO 5.1. The top ten results of the SIMPER analysis showing ecosystem goods and services, biodiversity features and uses that contributed most to the dissimilarities among stakeholders groups

AFOR= Artisanal Fishermen Organizations, NGO= Environmental NGOs, NAG= National Government Agencies, LOG= Local Governments, RES= Universities or Research Institutes, REG= Regional Government Agencies, LAND= Land Owners, TOUR= Tourism Enterprises. SD: standard deviation, Diss/SD: dissimilarity/standard deviation, Contrib%: % contribution to Diss/SD; Cum.%: % cumulative of the % contribution to Diss/SD.

Ecosystem goods and services						
Groups NGO & AFOR Average dissimilarity = 64.80	Av.Abund Group 1	Av.Abund Group 2	Av.Diss	Diss/SD	Contrib%	Cum.%
Habitat for migratory species	1.00	0.10	9.00	2.97	13.89	13.89
Wildlife watching	0.80	0.20	6.80	1.44	10.49	24.38
Spawning and nursery grounds	0.20	0.70	6.20	1.26	9.57	33.95
Habitat for charismatic species	1.00	0.40	6.00	1.21	9.26	43.21
Seafood	0.00	0.60	6.00	1.21	9.26	52.47
Fishing grounds	0.40	0.90	5.80	1.16	8.95	61.42
Kelp habitat	0.40	0.80	5.60	1.12	8.64	70.06
Environmental education	0.60	0.20	5.60	1.12	8.64	78.70
Tourism	0.20	0.40	4.40	0.88	6.79	85.49
Research	0.40	0.20	4.40	0.88	6.79	92.28
Groups NAG & AFOR Average dissimilarity = 57.17						
Wildlife watching	0.75	0.20	6.50	1.36	11.37	11.37
Habitat for migratory species	0.67	0.10	6.33	1.31	11.08	22.45
Habitat for charismatic species	1.00	0.40	6.00	1.22	10.50	32.94
Seafood	0.00	0.60	6.00	1.22	10.50	43.44
Spawning and nursery grounds	0.42	0.70	5.33	1.06	9.33	52.77
Fishing grounds	0.50	0.90	5.00	1.00	8.75	61.52
Tourism	0.50	0.40	5.00	1.00	8.75	70.26
Kelp habitat	0.58	0.80	4.50	0.90	7.87	78.13
Research	0.33	0.20	4.00	0.81	7.00	85.13
Aquaculture	0.00	0.40	4.00	0.81	7.00	92.13
Groups LAND & AFOR Average dissimilarity = 64.00						
Habitat for migratory species	1.00	0.10	9.00	2.92	14.06	14.06
Kelp habitat	0.00	0.80	8.00	1.95	12.50	26.56
Habitat for charismatic species	1.00	0.40	6.00	1.19	9.38	35.94
Seafood	0.00	0.60	6.00	1.19	9.38	45.31
Fishing grounds	0.50	0.90	5.00	0.97	7.81	53.13
Spawning and nursery grounds	0.50	0.70	5.00	0.97	7.81	60.94
Wildlife watching	0.50	0.20	5.00	0.97	7.81	68.75
Tourism	0.50	0.40	5.00	0.97	7.81	76.56
Research	0.50	0.20	5.00	0.97	7.81	84.38
Environmental education	0.50	0.20	5.00	0.97	7.81	92.19
Groups LOG & AFOR Average dissimilarity = 63.00						
Kelp habitat	0.00	0.80	8.00	1.95	12.70	12.70
Wildlife watching	1.00	0.20	8.00	1.95	12.70	25.40
Habitat for charismatic species	1.00	0.40	6.00	1.19	9.52	34.92
Seafood	0.00	0.60	6.00	1.19	9.52	44.44
Habitat for migratory species	0.50	0.10	5.00	0.97	7.94	52.38
Fishing grounds	0.50	0.90	5.00	0.97	7.94	60.32
Spawning and nursery grounds	0.50	0.70	5.00	0.97	7.94	68.25

Tourism	0.50	0.40	5.00	0.97	7.94	76.19
Research	0.50	0.20	5.00	0.97	7.94	84.13
Environmental education	0.50	0.20	5.00	0.97	7.94	92.06
Biodiversity features						
Groups RES & AFOR Average dissimilarity = 84.40						
Loco	0.00	1.00	10.00	-	11.85	11.85
Fisheries resources	0.00	0.70	7.00	1.51	8.29	20.14
Endemic flora	0.60	0.00	6.00	1.21	7.11	27.25
Marine mammals	0.60	0.10	5.80	1.16	6.87	34.12
Kelp	0.40	0.80	5.60	1.12	6.64	40.76
MEABRs	0.00	0.50	5.00	0.99	5.92	46.68
Islands system	0.40	0.30	4.60	0.91	5.45	52.13
Seabirds	0.40	0.20	4.40	0.88	5.21	57.35
Penguins	0.40	0.20	4.40	0.88	5.21	62.56
Recruitment zones	0.20	0.40	4.40	0.88	5.21	67.77
Groups REG & AFOR Average dissimilarity = 72.00						
Loco	0.00	1.00	10.00	-	13.89	13.89
Endemic flora	0.67	0.00	6.67	1.39	9.26	23.15
Dolphins	0.67	0.20	6.00	1.20	8.33	31.48
MEABRs	0.00	0.50	5.00	0.98	6.94	38.43
Islands system	0.33	0.30	4.33	0.86	6.02	44.44
Fisheries resources	0.67	0.70	4.33	0.86	6.02	50.46
Kelp	0.67	0.80	4.00	0.80	5.56	56.02
Seabirds	0.33	0.20	4.00	0.80	5.56	61.57
Recruitment zones	0.00	0.40	4.00	0.80	5.56	67.13
Whales migratory route	0.33	0.10	3.67	0.75	5.09	72.22
Groups NGO & AFOR Average dissimilarity = 82.80						
Loco	0.00	1.00	10.00	-	12.08	12.08
Fisheries resources	0.00	0.70	7.00	1.51	8.45	20.53
Dunes	0.60	0.00	6.00	1.21	7.25	27.78
Kelp	0.40	0.80	5.60	1.12	6.76	34.54
Seabirds	0.60	0.20	5.60	1.12	6.76	41.30
Penguins	0.60	0.20	5.60	1.12	6.76	48.07
MEABRs	0.00	0.50	5.00	0.99	6.04	54.11
Islands system	0.40	0.30	4.60	0.91	5.56	59.66
Dolphins	0.40	0.20	4.40	0.88	5.31	64.98
Marine reserve	0.40	0.10	4.20	0.84	5.07	70.05
Groups NAG & TOUR Average dissimilarity = 78.33						
Marine mammals	0.33	1.00	6.67	1.39	8.51	8.51
Islands system	0.67	0.00	6.67	1.39	8.51	17.02
Penguins	0.17	0.67	6.11	1.24	7.80	24.82
Dolphins	0.25	0.67	5.83	1.17	7.45	32.27
Endemic fauna	0.50	0.00	5.00	0.99	6.38	38.65
Endemic flora	0.50	0.00	5.00	0.99	6.38	45.04
Kelp	0.50	0.67	5.00	0.99	6.38	51.42
Coastal cultural heritage	0.33	0.33	4.44	0.88	5.67	57.09
Flowering desert	0.08	0.33	3.61	0.74	4.61	61.70
Rocky shore fishes	0.00	0.33	3.33	0.70	4.26	65.96
Groups NAG & AFOR Average dissimilarity = 80.00						
Loco	0.00	1.00	10.00	-	12.50	12.50
Fisheries resources	0.17	0.70	6.33	1.31	7.92	20.42
Islands system	0.67	0.30	5.67	1.14	7.08	27.50
Endemic fauna	0.50	0.00	5.00	1.00	6.25	33.75

Endemic flora	0.50	0.00	5.00	1.00	6.25	40.00
Kelp	0.50	0.80	5.00	1.00	6.25	46.25
MEABRs	0.00	0.50	5.00	1.00	6.25	52.50
Recruitment zones	0.08	0.40	4.17	0.84	5.21	57.71
Seabirds	0.33	0.20	4.00	0.81	5.00	62.71
Marine mammals	0.33	0.10	3.67	0.76	4.58	67.29
Groups LOG & AFOR Average dissimilarity = 87.00						
Loco	0.00	1.00	10.00	-	11.49	11.49
Kelp	0.00	0.80	8.00	1.95	9.20	20.69
Endemic flora	0.50	0.00	5.00	0.97	5.75	26.44
Marine mammals	0.50	0.10	5.00	0.97	5.75	32.18
Seabirds	0.50	0.20	5.00	0.97	5.75	37.93
Guanacos	0.50	0.00	5.00	0.97	5.75	43.68
Dunes	0.50	0.00	5.00	0.97	5.75	49.43
Terrestrial reserve	0.50	0.00	5.00	0.97	5.75	55.17
Marine reserve	0.50	0.10	5.00	0.97	5.75	60.92
Whales migratory route	0.50	0.10	5.00	0.97	5.75	66.67
Groups LAND & AFOR Average dissimilarity = 76.00						
Endemic flora	1.00	0.00	10.00	-	13.16	13.16
Loco	0.00	1.00	10.00	-	13.16	26.32
Dolphins	1.00	0.20	8.00	1.95	10.53	36.84
Endemic fauna	0.50	0.00	5.00	0.97	6.58	43.42
Kelp	0.50	0.80	5.00	0.97	6.58	50.00
Guanacos	0.50	0.00	5.00	0.97	6.58	56.58
Penguins	0.50	0.20	5.00	0.97	6.58	63.16
Islands system	0.50	0.30	5.00	0.97	6.58	69.74
MEABRs	0.00	0.50	5.00	0.97	6.58	76.32
Fisheries resources	0.50	0.70	5.00	0.97	6.58	82.89
Groups TOUR & AFOR Average dissimilarity = 79.33						
Loco	0.00	1.00	10.00	-	12.61	12.61
Marine mammals	1.00	0.10	9.00	2.95	11.34	23.95
Fisheries resources	0.00	0.70	7.00	1.50	8.82	32.77
Dolphins	0.67	0.20	6.00	1.20	7.56	40.34
Penguins	0.67	0.20	6.00	1.20	7.56	47.90
MEABRs	0.00	0.50	5.00	0.98	6.30	54.20
Kelp	0.67	0.80	4.00	0.80	5.04	59.24
Recruitment zones	0.00	0.40	4.00	0.80	5.04	64.29
Rocky shore fishes	0.33	0.10	3.67	0.75	4.62	68.91
Sea otter	0.33	0.10	3.67	0.75	4.62	73.53
Uses or activities						
Groups RES & AFOR Average dissimilarity = 66.40						
Scientific research	0.80	0.30	6.20	1.26	9.34	9.34
Restocking/restoration	0.00	0.60	6.00	1.21	9.04	18.37
Terrestrial reserves	0.60	0.00	6.00	1.21	9.04	27.41
Ecotourism and wildlife watching	0.60	0.20	5.60	1.12	8.43	35.84
Marine reserves	0.80	0.40	5.60	1.12	8.43	44.28
MEABR	0.40	0.60	5.20	1.03	7.83	52.11
Aquaculture	0.20	0.50	5.00	0.99	7.53	59.64
Environmental education	0.20	0.40	4.40	0.88	6.63	66.27
Artisanal fishing	0.60	0.90	4.20	0.84	6.33	72.59
Kelp harvesting	0.00	0.40	4.00	0.81	6.02	78.61
Groups NGO & AFOR Average dissimilarity = 66.00						
Scientific research	0.80	0.30	6.20	1.26	9.39	9.39

Restocking/restoration	0.00	0.60	6.00	1.21	9.09	18.48
Terrestrial reserves	0.60	0.00	6.00	1.21	9.09	27.58
Ecotourism and wildlife watching	0.60	0.20	5.60	1.12	8.48	36.06
Environmental education	0.80	0.40	5.60	1.12	8.48	44.55
MEABR	0.40	0.60	5.20	1.03	7.88	52.42
Marine reserves	0.60	0.40	5.20	1.03	7.88	60.30
Aquaculture	0.00	0.50	5.00	0.99	7.58	67.88
Artisanal fishing	0.60	0.90	4.20	0.84	6.36	74.24
Kelp harvesting	0.00	0.40	4.00	0.81	6.06	80.30
Groups NAG & LOG Average dissimilarity = 61.67						
MEABR	0.08	1.00	9.17	3.25	14.86	14.86
Ecotourism and wildlife watching	0.75	0.00	7.50	1.70	12.16	27.03
Artisanal fishing	0.58	0.50	5.00	0.98	8.11	35.14
Development renewable energy	0.00	0.50	5.00	0.98	8.11	43.24
Hotel infrastructure	0.00	0.50	5.00	0.98	8.11	51.35
Scientific research	0.92	0.50	5.00	0.98	8.11	59.46
Terrestrial reserves	0.25	0.50	5.00	0.98	8.11	67.57
Environmental education	0.75	0.50	5.00	0.98	8.11	75.68
Marine reserves	0.58	1.00	4.17	0.83	6.76	82.43
Restocking/restoration	0.33	0.00	3.33	0.69	5.41	87.84
Groups NAG & AFOR Average dissimilarity = 64.50						
Scientific research	0.92	0.30	6.67	1.41	10.34	10.34
Ecotourism and wildlife watching	0.75	0.20	6.50	1.36	10.08	20.41
MEABR	0.08	0.60	5.83	1.18	9.04	29.46
Environmental education	0.75	0.40	5.50	1.10	8.53	37.98
Restocking/restoration	0.33	0.60	5.33	1.06	8.27	46.25
Marine reserves	0.58	0.40	5.17	1.03	8.01	54.26
Aquaculture	0.00	0.50	5.00	1.00	7.75	62.02
Artisanal fishing	0.58	0.90	4.33	0.87	6.72	68.73
Kelp harvesting	0.08	0.40	4.17	0.84	6.46	75.19
Leisure and recreation	0.33	0.00	3.33	0.70	5.17	80.36
Groups LAND & AFOR Average dissimilarity = 65.00						
Terrestrial reserves	1.00	0.00	10.00	-	15.38	15.38
MEABR	0.00	0.60	6.00	1.19	9.23	24.62
Restocking/restoration	0.00	0.60	6.00	1.19	9.23	33.85
Marine reserves	1.00	0.40	6.00	1.19	9.23	43.08
Aquaculture	0.00	0.50	5.00	0.97	7.69	50.77
Ecotourism and wildlife watching	0.50	0.20	5.00	0.97	7.69	58.46
Leisure and recreation	0.50	0.00	5.00	0.97	7.69	66.15
Scientific research	0.50	0.30	5.00	0.97	7.69	73.85
Environmental education	0.50	0.40	5.00	0.97	7.69	81.54
Kelp harvesting	0.00	0.40	4.00	0.80	6.15	87.69

ANEXO 5.2. The top ten results of the SIMPER analysis showing biodiversity features that contributed most to the dissimilarities between type of users (direct and indirect)

SD: standard deviation, Diss/SD: dissimilarity/standard deviation, Contrib%: % contribution to Diss/SD; Cum.%: % cumulative of the % contribution to Diss/SD.

Biodiversity features						
Groups Direct & Indirect Average dissimilarity = 76.99	Av.Abund Group 1	Av.Abund Group 2	Av.Diss	Diss/SD	Contrib%	Cum.%
Loco	0.04	0.60	5.93	1.20	7.70	7.70
Kelp	0.44	0.73	5.26	1.05	6.83	14.53
Islands system	0.48	0.27	4.91	0.98	6.38	20.91
Endemic flora	0.48	0.20	4.89	0.98	6.35	27.26
Fisheries resources	0.22	0.47	4.81	0.96	6.25	33.52
Dolphins	0.26	0.40	4.52	0.91	5.87	39.38
Marine mammals	0.33	0.27	4.22	0.85	5.48	44.87
Seabirds	0.37	0.20	4.22	0.85	5.48	50.35
Penguins	0.26	0.33	4.20	0.85	5.45	55.81
MEABRs	0.00	0.33	3.33	0.71	4.33	60.13

ANEXO 5.3. Betweenness and normalized betweenness centrality scores by each environmental component. Scores calculated in UCINET 6.0

	Betweenness	normBetweenness
Marine reserve	10.143	4.83
Habitat for charismatic species	9.445	4.498
Ecotourism	8.304	3.954
Wildlife watching	7.982	3.801
Artisanal fishing	5.714	2.721
Scientific research	4.356	2.074
Fishing grounds	3.826	1.822
Kelp habitat	3.046	1.451
Fisheries resources	3.026	1.441
Habitat for migratory species	2.671	1.272
Environmental education	2.627	1.251
Islands system	1.915	0.912
Marine mammals	1.456	0.693
Seabirds	1.456	0.693
Endemic flora	1.234	0.588
Kelp	0.798	0.38