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Sección Especial

Conservation of ecosystem services in high-altitude Andean wetlands: social participation in the creation of a natural protected area

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Abstract. The goal of the present work is to synthesize the process of collective construction developed to protect the high-altitude wetlands of the Blanco River basin, located in the Andes Mountains, Province of Mendoza. The participatory process arose out of an initiative of basin residents and users, and was conducted by the Integrative Committee for Creation of Potrerillos Municipal Environmental Protected Area (MEPA), composed of civil society organizations, government agencies and scientific institutions. The major pressures affecting the wetlands, identified through participatory assessment of the socio-ecosystem are: water pollution, reduction and total loss of habitat, stoppage of groundwater flows, artificial drainage, poldering of the meadow, and fragmentation of the wetland system, among other pressures. In order to identify priority sites for conservation of the ecosystem services (ES) wetlands provide, local people identified and prioritized the six most important of them, according to their perception: water for human consumption, agriculture and industry, aesthetic, spiritual and non-use representations, recreation and ecotourism, erosion control, water regulation and regulation of the biotic environment. The areas supplying ES were identified on the map of land use and land cover of the basin, with the wetland area, with tourist use and water catchment, and the watershed's headwaters standing out as areas with higher ES provision. This process culminated in the creation of a protected area to halt the intense degradation affecting the wetland system, promoting maintenance of the natural area and improving its provision of ES. This collective process allowed integrating local and scientific knowledge, becoming an experience to be replicated in other areas in terms of conservation and land management. Among its major strengths is a strong coordination between the different social actors involved, which allowed success in reaching the implementation stage of a public policy for conservation.

[Keywords: community conservation strategy, assessment, beneficiaries, mapping, high Andes, land use, watershed, land-use planning]

Resumen. Conservación de servicios ecosistémicos en humedales altoandinos: la participación social en la creación de un área natural protegida. El objetivo del presente trabajo consiste en sintetizar el proceso de construcción colectiva desarrollado con el fin de proteger los humedales de altura pertenecientes a la cuenca del Río Blanco de Potrerillos, localizados en la Cordillera de Los Andes, Provincia de Mendoza. El proceso participativo surgió ante una iniciativa de los pobladores locales y usuarios de la cuenca, y fue conducido por la Comisión Integradora para la Creación del Área Ambiental Protegida Municipal (AAMP) Potrerillos, integrada por organizaciones de la sociedad civil, instituciones gubernamentales y organismos científicos. Las principales presiones que afectan al humedal, identificadas a través del diagnóstico participativo del socio-ecosistema son: contaminación del agua, reducción y pérdida total de hábitat, corte del flujo de alimentación, drenaje artificial, polderización definitiva de vegas, fragmentación del sistema hidrológico, entre otras. A fin de determinar los sitios prioritarios para la conservación de servicios ecosistémicos (SE) que brinda el Sistema de humedales, la población local identificó y priorizó los seis más importantes de acuerdo a su percepción: agua para consumo humano, agricultura e industria; representaciones estéticas, espirituales y de no uso; recreación y ecoturismo; regulación de la erosión; regulación del ciclo hídrico y del ambiente biótico. Sobre el mapa de uso y cobertura de la tierra de la cuenca, fueron identificadas sus zonas proveedoras, destacándose el área de humedales con uso turístico y captación de agua, y las cabeceras de cuencas hídricas como las zonas con mayor provisión de SE. Este proceso culminó con la creación de un área natural protegida para detener el proceso de degradación intensiva que afecta al humedal, lo cual promueve el mantenimiento y la mejora de sus SE. Este proceso colectivo permitió integrar saberes locales con conocimiento científico, y se constituyó como una experiencia a replicar en otros territorios en el plano de la conservación y del ordenamiento territorial. Entre sus principales fortalezas se destaca la articulación sólida entre los diferentes actores sociales involucrados, que permitió alcanzar con éxito la etapa de implementación de una política pública de conservación.

[Palabras clave: estrategia comunitaria de conservación, valoración, beneficiarios, mapeo, Altos Andes, usos del suelo, cuencas hidrográficas, ordenamiento territorial]

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Introduction

Wetlands are considered to be ecosystems of high value for nature conservation because the hydrologic and ecological processes occurring in them are vital to the development of life at planetary scale. Furthermore, wetland systems located in drylands are strategic due to the ecosystem services (ES) they provide, and to their functions relative to climate change adaptation and mitigation of desertification processes (IPCC 2007; Ramsar Convention 2002a, 2002b). In this respect, the Ramsar Convention (2015a) points out that "…their degradation and loss will further reduce the mitigation and adaptation capacity of wetlands, since the conservation and wise use of wetlands have the potential to halt this degradation (…) given their crucial role in carbon sequestration and storage…". Wetland systems, just as all of the socio-ecological systems located in drylands, are particularly sensitive to the interactions between processes of climate change and land degradation (Ramsar Convention 2015b; Reed and Stringer 2015). So, studying, sustainably managing and conserving them is essential to the wellbeing of communities.

Wetland ecosystems can be considered socio-ecological systems, where the social and ecological dimensions, as well as their interrelations, make up an integral unit (Ostrom 2009). In this context, humans are part of the ecosystem and they constitute a key factor in the system dynamics (Folke 1998). This holistic and integrated approach, under a model of social participation, enriches understanding of the relationships, interactions and feedbacks between ecological and social systems.

The creation of the Potrerillos MEPA, based on the protection of the Blanco River basin wetlands in Mendoza province, sets a concrete example of participation and involvement of different stakeholders in the ecosystem services framework (Constanza et al. 1997; MEA 2005). Under the principles proposed by the Ecosystem Approach to conservation as defined by the Convention on Biological Diversity (CBD/UNEP 1999), the participation of local actors is essential throughout the whole process. Participation may be defined as the practice of consulting and involving members of the public in the agenda-setting, decision-making, and policy-forming activities of organizations or institutions responsible for policy development (Rowe and Frewer 2004). In recent years, the interest in involving the public in decision making about science and technology policy has increased, especially on issues concerning environmental management (Rowe and Frewer 2000). The participatory process in the Blanco River basin originated through an initiative of permanent and temporary residents of the mountain villages settled in the watershed, who submitted a claim to the municipal authorities for the negative impacts on the provision of ES in the wetlands, specifically on the quality and quantity of water resources and scenic beauty of the basin's landscape.

The continuous changes in land use and land cover occurring in the area intensify these impacts. These profound changes are linked to the explosive and unplanned growth of residential land use, related to the real estate speculation triggered by the construction of the Potrerillos dam in the 2000s. Significant changes in land use can be observed, related to the possibility of using water in this hydrographic unit (whether surface, subsurface and/or groundwater) and to the expansion of residential land use associated with tourism. In this regard, it is important to mention that the change in land use and land cover generally brings with it substantial losses in the provision of goods and ES (Lambin et al. 2001; Foley et al. 2005; Mezger et al. 2006; Paruelo et al. 2006; Young et al. 2006; Laterra et al. 2010). De Groot et al. (2010) undertook an integral approach to the problem at the landscape scale, based on assessment of the direct and indirect impacts of land-use and land-cover changes on the flow of ES. In particular regard to wetland ecosystems, these changes in land use are the primary cause of ES loss (Zorrilla-Mirás 2014). In relation to land-use changes, their effects on water balance should be highlighted because of the strong control that vegetation has on key hydrologic variables such as evapotranspiration (Nosetto et al. 2005).

In response to this demand, the Municipality of Luján de Cuyo coordinated the process of creating the natural protected area (NPA). It was accompanied by the Ministry of Land, Environment and Natural Resources of the Government of Mendoza, and supported by the scientific sector through the Argentine Dryland Research Institute (IADIZA) of the National Council for Scientific and Technical Research (CONICET).

The goal of the present work is to synthesize the participatory process developed to protect the Blanco River basin wetlands, which led to the creation of a natural protected area that allows halting the intense degradation process affecting the wetlands, and that promotes maintenance and improvement of their ES. It is intended to highlight the importance of incorporating the community's perception of their natural resources and ES in designing a conservation strategy.

Materials and Methods

Study area

The study area comprises the watershed of the Blanco River in Potrerillos, which lies between the following geographic coordinates: from 32°54′ to 33°0′ (South Latitude) and from 69°11′ to 69°27′ (West Longitude), covering about 300 km^2 of a key area located on the western portion of the Department of Luján de Cuyo, Province of Mendoza, Argentina

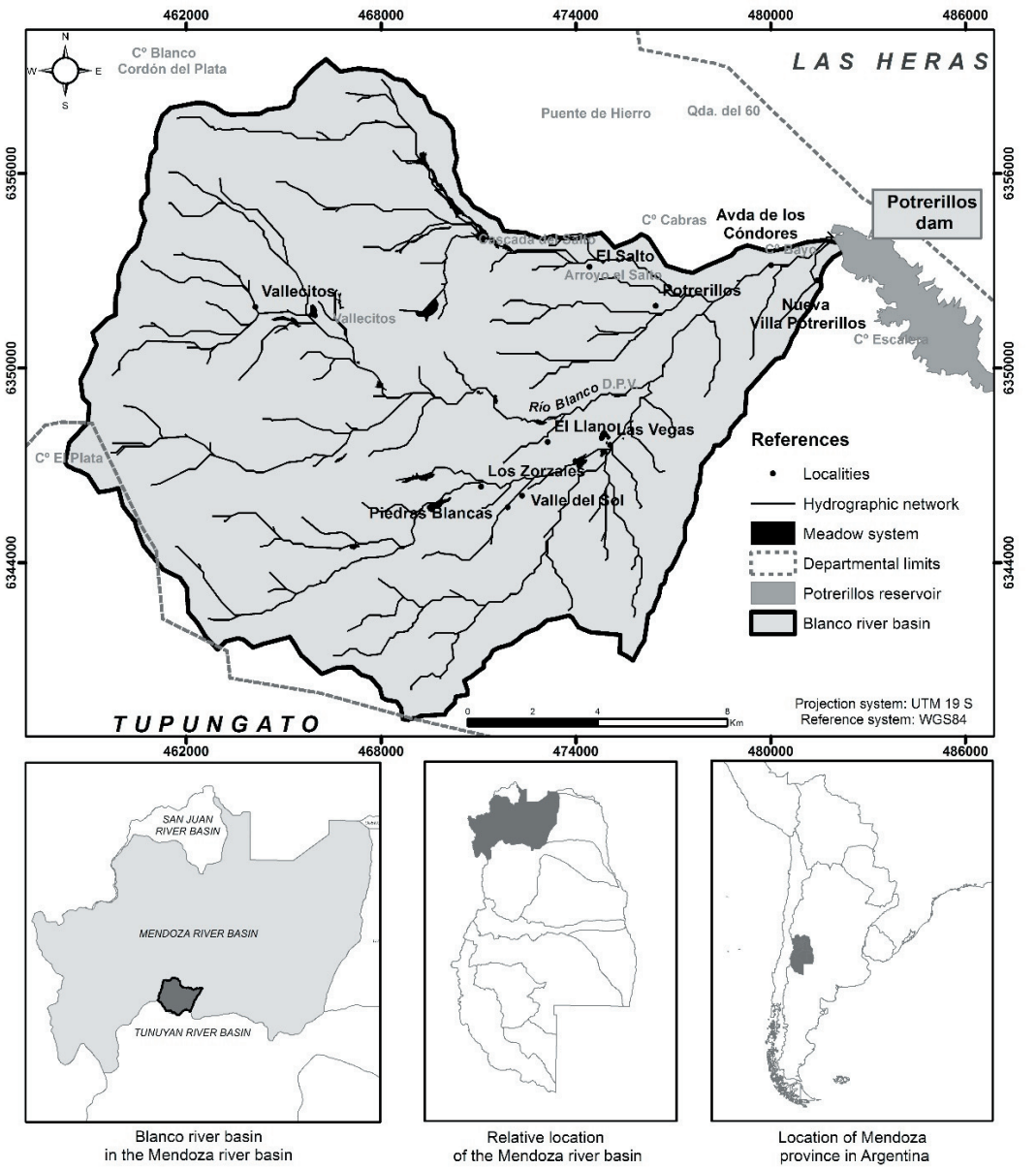

Figure 1. Location of the wetland system in the Blanco River basin of Potrerillos. Mendoza, Argentina. Distribution of the population centers responds to a dendritic pattern of drainage network.

Figura 1. Localización del sistema de humedales en la cuenca del río Blanco de Potrerillos. Mendoza, Argentina. La distribución de los núcleos poblacionales responde al patrón dendrítico de la red de drenaje.

(Figure 1). This hydrographic unit falls entirely within the Potrerillos district, with its ending point being the area's main village, precisely at the Blanco River outlet into the Potrerillos dam. The wetlands developing in there are part, at national scale, of the High Andean or High Andes ecoregion (Burkart et al. 1999) and, at regional scale, of the South American high-altitude wetlands (Ramsar Convention 2005). They belong to the greater Mendoza River basin, which stretches over the NW of the province, and feeds the oasis of the Mendoza River whose waters flow from snowmelt and thawing from the high peaks of the Andes.

The Blanco River watershed wetlands are a concrete example of the high susceptibility of this kind of ecosystems to the impact of a set of external and internal factors. The vulnerability of this wetland system increases if it is considered that it lies within the South American Arid Diagonal (Bruniard 1982), and is part of Argentina's drylands. According to the Aridity Index (UNEP 1997), based on the precipitation/potential evapotranspiration relationship, this high-altitude wetland system is embedded within the dry subhumid area. Similarly to all of the ecosystems belonging to the Province of Mendoza, the referenced wetlands are affected by desertification processes that range from moderate to very severe, and the trend is a growing one (Roig et al. 1991; Abraham and Salomón 2011). According to their high susceptibility, global climate change provides a context in which acceleration of the degradation of these ecosystems, and even the disappearance of many of them, is to be expected, as well as the loss or decline of the species inhabiting them (Kusler et al. 1999; MEA 2005). For the Central Andes, an increase of 3 to 4 °C in summer temperatures is foreseen for the end of the 21st century, compared to the temperatures occurring between 1960 and 2000 (Villalba and Boninsegna 2009).

The district of Potrerillos has a stable population of about 3000 people (DEIE 2010), which showed a strong increase, of 44%, in the last inter-census period, with 1682 people having been surveyed in 2001 (DEIE 2001). This remarkable rise in population number may have been due to the growing expansion of economic activities in the area, primarily associated with mountain tourism. In this regard, an aspect to be highlighted is the privileged location of Potrerillos city, there being two factors that exalt the territory: the Central Bi-oceanic Corridor and the Potrerillos dam. This locality receives an influx of regional, national and international visitors, has high tourism potential and the possibility of getting investments on different types of supplementary economic activities (Gudiño 2006). Formerly, the area's economic development was strongly linked to the Trans-Andean Railway, so its disappearance entailed changes in the activities developed by the local residents, who turned primarily to the tourism sector.

In order to understand the effects that the land-use dynamics in the Mendoza River basin had on the socio-ecological system of the Blanco River basin wetlands and their ES, it is important to analyze the strong territory imbalances characterizing both, this hydrographic unit and the entire province. The first thing noticed is a large concentration of population and activities in the irrigated oases (North, Central, South Oases and those in Malargüe and Uspallata), which represent only 4.5% of the province's land area and house 98.5% of the population. In contrast, there is a large expanse of non-irrigated land (about 95.5%) inhabited by only 1.5% of the province's population (Abraham et al. 2014). These marked asymmetries become even larger in the Mendoza River basin where, as part of the North Oasis, Greater Mendoza develops as the main urban area in Argentina's west. The area concentrates approximately 80% of the people, with the environmental consequences that such disparity generates.

Methodological design of the participatory process

Faced with the repeated claims from permanent and temporary residents of the Basin, due to the environmental degradation of the wetlands, the Municipality of Luján de Cuyo launched a participatory process to define the conservation goals for creating a NPA. Under the guidelines proposed by the Ramsar Convention and based on the principles of the ecosystem approach, in order to establish and strengthen involvement of local peoples in the process of creation of a natural protected area right from the start, the Municipality of Luján de Cuyo convened different entities. The map of actors was established from the beginning, including neighborhood unions, business chambers, representatives of educational institutions, sports associations, ungrouped local community representatives and members

of the scientific and government sectors. It is important to mention that, in order to have an appropriate legal framework to begin the collective process, in 2010 the Municipality of Luján de Cuyo formed the Integrative Committee for Creation of the Potrerillos MEPA (Resolution N° 400).

The working methods adopted were carried out between 2010 and 2012. The participatory process was structured into three stages: participatory environmental diagnosis of the Blanco River basin (stage 1); identification, assessment and mapping of ES and their supplier areas in the watershed (stage 2), and design and formulation of the proposal for creation of the NPA (stage 3). The actors participated in each of these stages according to their level of involvement in the process (Figure 2).

Stage 1. Participatory environmental diagnosis of the Blanco River basin

This stage was coordinated by the Municipality of Luján de Cuyo, between the months of May and December 2010. Construction of the diagnosis involved all stakeholders in the Committee for Creation of the Potrerillos MEPA, which was composed of twenty-three representatives of municipal and provincial agencies (Resolution No. 400 of the Municipality of Luján de Cuyo) and civil society representatives. To prepare the aforementioned diagnosis, three open workshops were held in Potrerillos, the main village in the watershed. Through an outreach strategy in local media, the entire local community was convened, while the other actors were formally invited by the Municipality. At this stage, the participation mechanism was based on an open and public query to the whole community. Sixty percent of the attendees were from government institutions, 20% of them represented civil society organizations and the remaining 20% were ungrouped residents of the area. At the same time, IADIZA, the research institute that the authors of this study belong to, drew up the socio-ecosystem inventory of the Blanco River basin wetland (Rubio, 2012), as an input for the participatory environmental diagnosis. This synthesis work provided the participants with mapped thematic data on the physical-biological subsystem (i.e., wetlands, soil, vegetation, geology, geomorphology, climate, among others) and on the socioeconomic subsystem (i.e., human settlements, land use, infrastructure and services).

The major pressures undergone by the ecosystem were defined during these workshops, going deeper in the analysis of ES degradation. To do this, we worked on analyzing the systems that make up the socio-ecological system (physical, biological and socio-economic), and on identifying their particular environmental issues. Participants were organized in heterogeneous groups to promote discussion, and the tree problem was used as a tool for identifying the main pressures and consequences of the degradation of these wetlands (Chevalier and Bucles 2009). Once the problems had been listed by the groups, they were exposed and ranked in a general discussion. As a final activity, a plenary session was held as closure to this stage, in which the conservation goals of the new NPA were defined through discussion and subsequent consensus.

Stage 2. Identification, assessment and mapping of ES and their supplier areas in the watershed

This stage was led by IADIZA. In order to identify and rank the most important ES in the watershed, ten interviews were conducted with a set of key informants, representative of the different sectors (government, scientific, civil society organizations, permanent and temporary residents). A list was provided including the ES defined by the Ecosystem Millennium Assessment (2005), whose classification was later adapted by Haines-Young and Potschin (2011), to be selected by interviewees. To make the analysis and subsequent mapping easier, they were asked to select only the six most important ES according to their perception.

Once the six major ES in the watershed were defined, eighty structured surveys were conducted, involving permanent and seasonal residents in the El Salto and Las Vegas locations (chosen for their heterogeneity of permanent residents and tourists). The sample size was estimated with a confidence of 95% (α=0.05; $Z\alpha$=1.96), with a population of one thousand. The aim was to know about the population's perception of the worth of the ES provided by the watershed ecosystems and their relation to land use. The structured surveys were conducted at random on weekends with greater tourist influx, visiting homes and shops at each of the study sites.

The initial part of the interview included a brief description of each selected ES and a definition of its supplier area (Martín-López

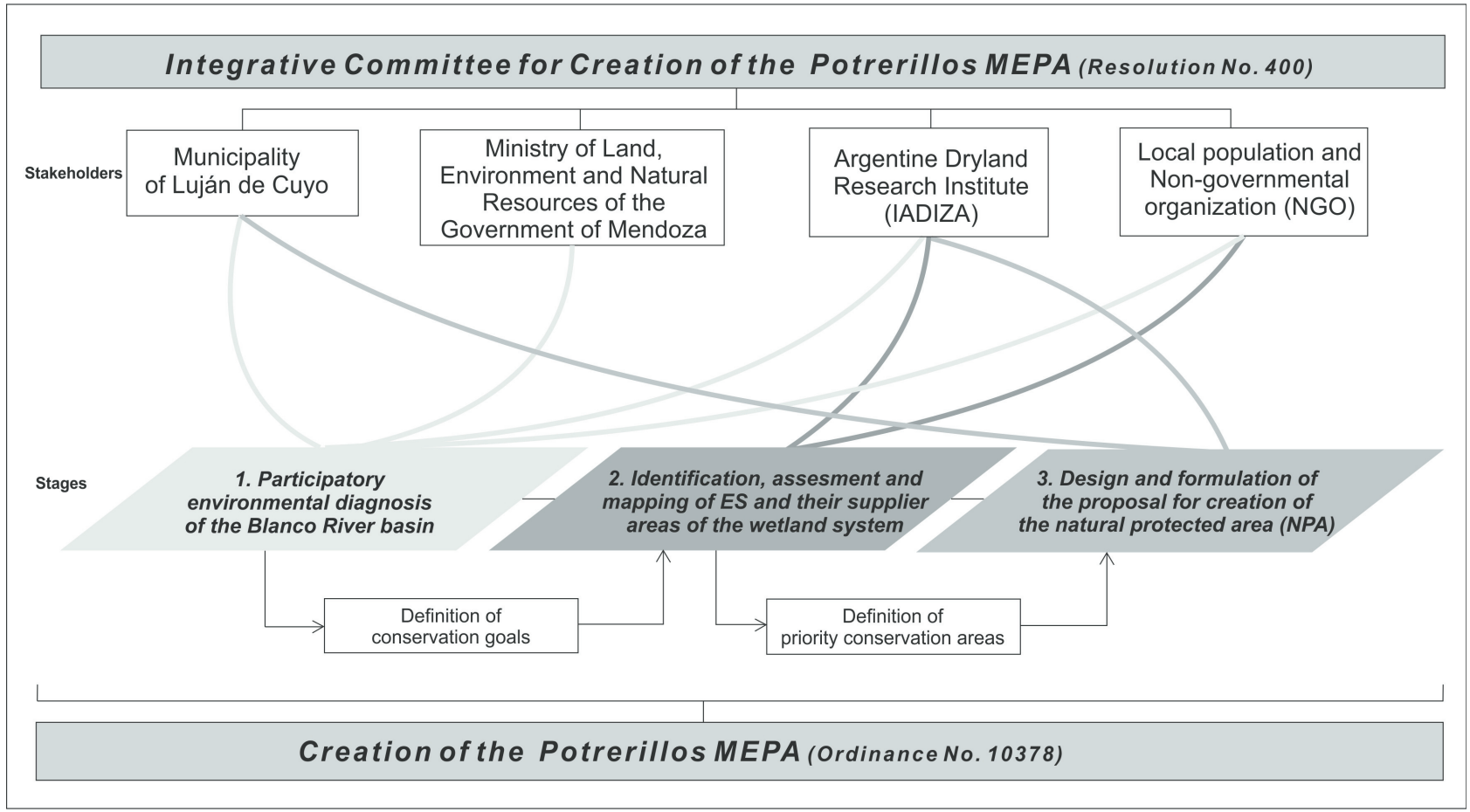

Figure 2. Participatory process scheme for creation of the Potrerillos MEPA. The lines with different shades of gray show the linkage between different social actors and each stage of the participatory process, which resulted in the creation of the protected space.

Figura 2. Esquema del proceso participativo para la creación del AAMP Potrerillos. Las líneas con diferentes tonos de grises muestran la vinculación de los diferentes actores sociales con cada etapa del proceso participativo, cuyo resultado fue la creación del espacio protegido.

& Montes 2011), so as to bring these concepts closer to the surveyed population. Basing on the six ES prioritized by the group of key informants, surveyed people were asked to identify their supplier areas using the land-use map as a reference. To this end, the map used was that of land use and land cover of the Blanco River basin, which had been previously created by IADIZA (Figure 3), whose legend incorporates the major features of the landscape in order to make it easier for interviewees to identify each area.

The resulting data served to obtain an assessment of each ES and their relationship with potential supplier areas (kinds of land use). This was performed by classifying the frequency of responses that related each ES to a supplier area, thus obtaining five types of assessment (from very low to very high). Aiming to define priority areas for conservation, the results obtained at the previous stage were pondered, and given values from 1 (very low) to 5 (very high). Subsequently, a summation was made for each area, thus determining the priority land uses to be conserved, which were mapped with geographic information system.

Stage 3. Design and formulation of the proposal for creation of the NPA

The Municipality of Luján de Cuyo led the final stage. The results obtained were handed over to the corresponding decision makers, who set up the legal framework needed for creation of the area and sanctioned the project that gave origin to the Potrerillos MEPA.

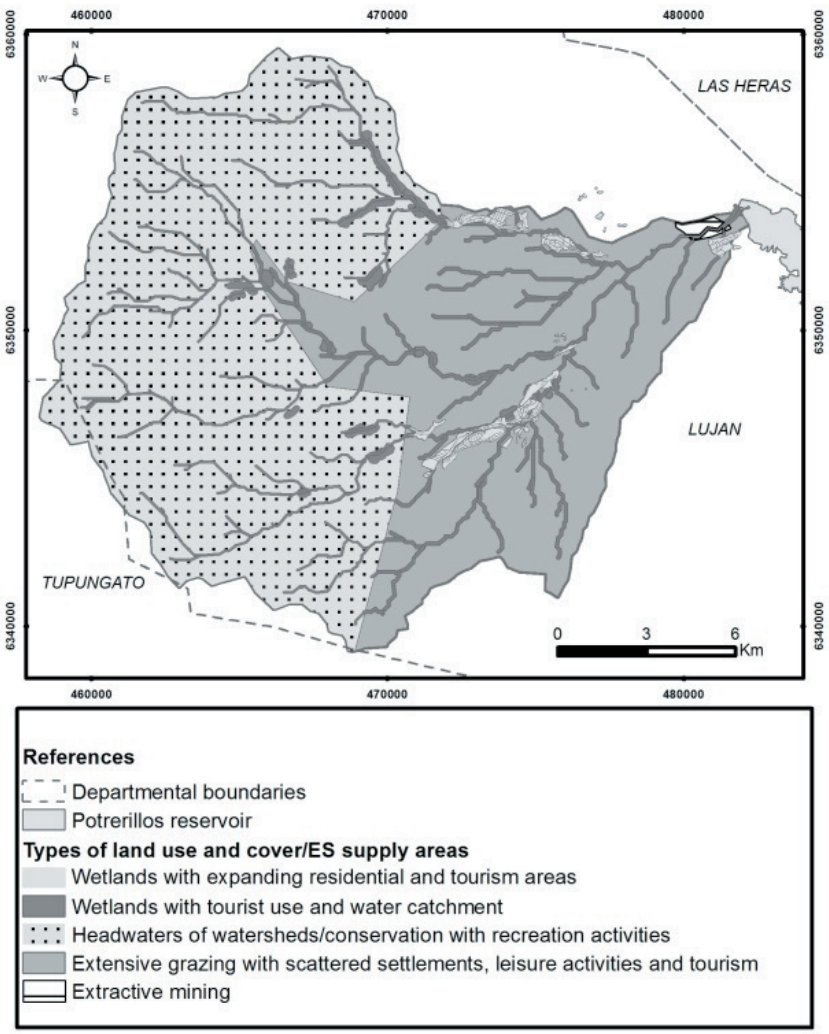

Figure 3. Land use and land cover in the Blanco River basin. The population surveyed identified five ES supplier areas.

Figura 3. Uso del suelo y cobertura en la cuenca del Río Blanco. La población encuestada identificó cinco áreas proveedoras de SE.

Results

Pressures on wetlands

The major pressures affecting the ecosystems in the socio-ecological system of the studied watershed were addressed in the participatory environmental diagnosis. These pressures are mostly associated with absence of land-use planning policies for the area, with intensification of unplanned tourism and residential uses and with a significant increase in permanent and temporary population. The impacts derived from human activities are multiple, depending on the scale of analysis at which they are considered. The advance of unplanned residential activities has triggered a series of modifications in the watershed landscape which have severely affected the system of meadows linked to the hydrographic network, causing loss of plant cover, fragmentation and pollution of these hydrologic systems.

Outstanding among the major environmental issues that were collectively detected are the degradation of ecosystems and their capacity to provide ES, impairment of the hydrologic system, loss of biodiversity, introduction of exotic species, increased desertification and land degradation processes, increased alluvial risk from continuous clearing and clandestine building activities in vulnerable areas (physical-biological system). As to the socioeconomic system, there is notorious concern about social conflicts between new and historical residents in the area, also noticeable are strong deficiencies in availability of infrastructure, equipment and services (stressed in the vacation season by an exponential population increase), inaccessibility to areas of public use due to illegal appropriations, fencing of river and stream banks, poor acknowledgment of the local archaeological heritage, among other environmental problems.

The pressures affecting the wetlands brought about a series of impacts that translated into an alteration of the ES provided by both, the water resource and the system of related meadows. In the case of water supply services, the increase in population not only implied increased consumptive use of the water from rivers and streams, but also affected water quality because of the growing pollution originating from the discharge of household effluents contaminated with feca-coliform bacteria and manure from livestock grazing in the wetland meadows. Regarding the degradation of meadow environments, support services stand out among the main ES critically compromised by residential progress because of a reduction of the area of soil formation and nutrient generation. With regard to regulation ES, the hydrologic cycle is affected by a temporary and even definitive alteration of hydrologic conditions. Artificial drainage into the meadow system, stoppage of groundwater flows and refilling and final poldering of the meadow are frequent impacts that result in fragmentation of the hydrologic system. In turn, climate regulation ES have their capacity reduced, both at local level, because of an alteration of biological functions relative to cooling by evapotranspiration (Ramsar Convention 2002a), and at regional level in a context dominated by dryness (Ramsar Convention 2002c). Closely associated with biodiversity, the habitat for numerous species appears highly affected by diminishment of this ecosystem. Related to cultural services, the degradation of this wetland system has negative repercussions on the scenic beauty of the landscape, reducing the possibilities for sustainable tourism activities which are a source of labor for the communities living in the area.

Finally, according to the points made by the participants of the workshops, a consensus was reached regarding conservation goals to be included in the proposed creation of the new protected area: to conserve water sources and bodies, preserve the landscape, integrate activities associated with tourism for conservation and preserve biodiversity of the wetlands.

ES of the Blanco River basin and their supplier areas

Concerning the identification, assessment and mapping of ES and their supplier areas, obtained results indicate that, according to the perception by key informants interviewed and to the subsequent ranking made by the surveyed population, the six ES more relevant to the area are: a) water for agriculture, human consumption and industrial use, b) aesthetic, spiritual and non-use representations, 3) recreation and ecotourism, 4) erosion regulation, 5) regulation of the water cycle, and 6) regulation of the biotic environment. The assessment achieved denotes that 53.7% of the surveyed population believes that the major ES in the watershed is water supply, in second place follows the cultural ES relative to the scenic beauty of the landscape (20%). In contrast, the regulation ES related to the biotic environment, specifically to habitat

biodiversity, was ranked first place only by 1.2% of interviewees.

The first place assigned to the ES of water supply for different uses is explained in the dryland context, where water resource availability is low and deficient. The amount and quality of water provided by the Blanco River watershed wetlands play a central role at both, local and regional scales. Within the watershed, the water supply service allows providing water to a permanent population of around 3000 (DEIE 2010). Being eminently a tourist resort, located very near the capital city of the province, Potrerillos shows a significant increase in population, by up to fivefold, in the summer season. Regarding the supply of drinking water to certain areas of the North Oasis, it is implemented from the Water Treatment Plant in Potrerillos that takes its water from the Blanco River. Two aqueducts, 52 km in total length, transport water to the Mendoza Metropolitan Area. Their maximum capacity for carrying water is 1 m^3/s, which represents 10% of the demand for water to be made drinkable for the residents of the Mendoza Metropolitan Area. Considering that treated drinking water reaches alarming values of consumption and waste (710 $L.inhab^{-1}.day^{-1}$) (Salomón 2010), the Water Treatment Plant is estimated to supply water to at least 90000 people. The contribution of water resources (surface and groundwater) by the supplier areas located in the upper reaches of the basin (upper area of the Mendoza River basin) to the demanding areas situated in the oasis (middle part) and in the Travesía of Guanacache plain (lower part) has been verified through the isotope composition of phreatic waters (Jobbágy et al. 2011). In the oasis, the demands for water are aimed at consumptive uses such as irrigation

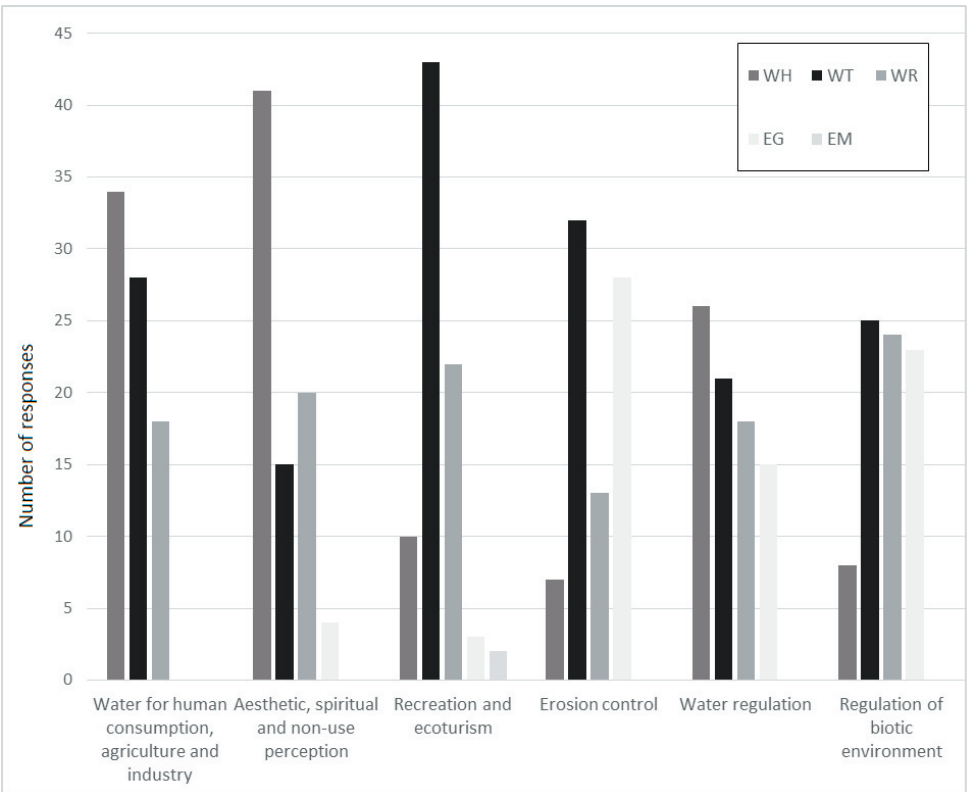

Figure 4. ES identification in relation to their supplier areas. The graphic shows, according to the perception of the population, the relationship between each supplier area and the type of ES it provides. Bars indicate the number of people who identified each type of ES in their corresponding supplier area. WH = watershed headwaters; WT = wetlands with tourist use; WR = wetlands with expanding residential and tourism areas; EG = extensive grazing; EM = extractive mining.

Figura 4. Identificación de los SE de acuerdo a las zonas proveedoras. El gráfico muestra, de acuerdo a la percepción de la población, la relación existente entre cada zona proveedora de servicios y el tipo de SE que esta brinda. Las barras indican la cantidad de personas que identificaron cada tipo de SE según su área proveedora. WH = cabeceras de cuencas hídricas; WT = humedales con uso turístico; WR = humedales con zonas residenciales y turismo en expansión; EG = pastoreo extensivo; EM = uso extractivo minero.

of agricultural lands, industrial and human water consumption downstream, as well as for non-consumptive uses such as hydroelectric generation and cooling -provisioning systems (DGI 2006).

The perception of the geographic location of the areas supplying prioritized ES indicates that, except for extractive mining, all of the areas corresponding to each land use provide at least three types of ES (Figure 4). The wetland area with tourist use and water catchment was the one most frequently identified as a supplier area, having been selected in 14% of the cases. In second place, representing 26% of the cases studied, is the area corresponding to the basin headwaters, where land use is aimed at conservation of natural resources. The area defined by mining land use is only identified as a supplier of recreational and ecotourism ES, because of its possibilities in terms of mining tourism, an incipient activity in the province.

Figure 5 shows the relevance allotted to each ES supplier area, depending on the service involved. The upper and middle parts of the basin, an area of development of the wetland system, are identified as areas supplying ES related to the water resource (water supply and regulation of water flows). Besides, the areas where the wetlands occur are also frequently identified as suppliers of recreational and tourism ES.

Supply of the erosion regulation ES was widely recognized for the wetland areas, which can be associated with recent landslide events and mass removal processes occurred in the basin (Rubio et al., personal observation). Consistently, results referring to the priority sites for ES conservation in the Blanco River watershed (Figure 6) denote that both the supplier area corresponding to the wetlands with tourism and residential use and the watershed headwater area exhibit the highest priority for conservation.

Creation of the protected area

Regarding the formulation of the proposal for creation of the NPA, the starting point was the definition of protected area given by the International Union for Conservation of Nature (IUCN): "...A clearly defined geographic space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values…" (Dudley 2008). When defining the area, priority was given to the integrated conservation of the watershed; and as the headwaters are protected by the Cordón del Plata Provincial Park (6000 m a.s.l.), the project included the middle and lower parts of the watershed up to its outlet into the Potrerillos dam (1381 m a.s.l.) (Figure 7). In delimiting the area, priority sites were considered according to their level of provision of ES (as perceived by the surveyed population), specifically those related to the water resource and its associated meadows and marshlands. Two proposals for delimitation of the NPA were put forward. From the scientific sector, IADIZA proposed a definition of the area based on the results obtained from stages 1 and 2 of the process, prioritizing the connectivity of the basin's ecosystems (Rubio 2012). This proposal was intended for the protection of the biological corridors established between the watershed upper (Cordón del Plata Provincial Park) and lower parts (unprotected middle and lower watershed sections), thus facilitating compliance with the conservation and management objectives devised for the NPA (Meffe and Carroll 1997). The second proposal, put forth by the Municipality, was included in the demarcation of the boundaries of the Blanco River basin and other areas within the Department of Luján de Cuyo, far away from this hydrographic unit, a proposal that was ultimately selected. Unlike the first proposal, the selected one disregards the results for previous stages of the participatory process, prioritizing the protection of a larger area over the provision of ES by the watershed.

Finally, three years after the collective working process was started, it culminated with the creation of the Potrerillos MEPA through Ordinance No. 10378 of the Municipality of Luján de Cuyo, designated a Multiple-Use area under Category VIII (IUCN, 1994). Figure 7 shows the final design adopted for the new protected area and its integration into a regional conservation strategy for the high Andes ecoregion, contributing to the comprehensive protection of glacial bodies and wetland systems located in the Aconcagua, Tupungato and Cordón del Plata provincial parks and in Puente del Inca nature reserve, all of them belonging to the NPA system of Mendoza province (Rubio et al. 2014).

Main strengths and weaknesses of the process

The participatory process developed is a successful integration experience between

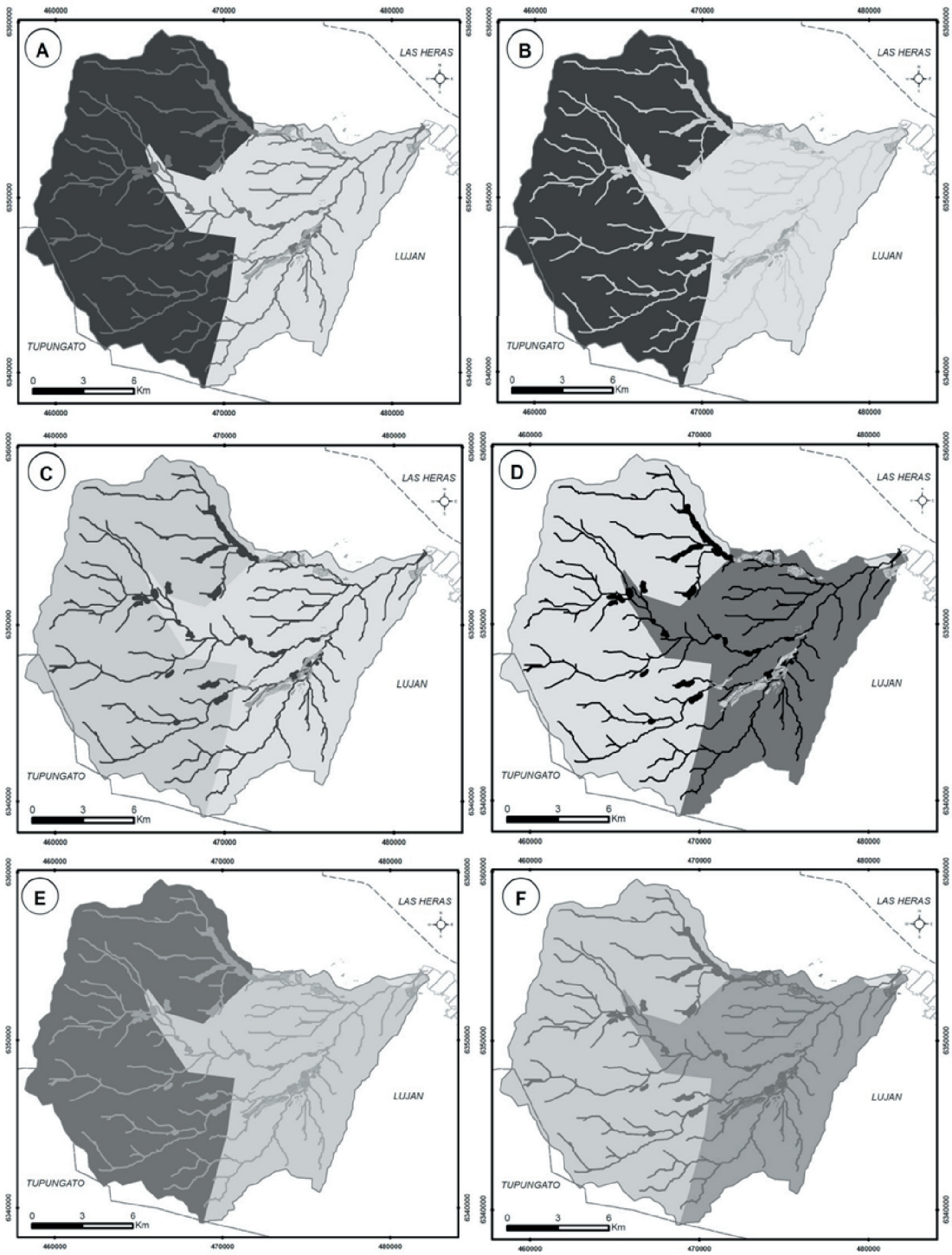

Figure 5. Assessment of supplier areas according to the ES identified. Maps: A) Water for agriculture, industry and human consumption; B) Aesthetic, spiritual and non-use representations; C) Recreation and ecotourism; D) Erosion control; E) Water flow regulation; F) Biotic environment regulation. Scale: Very low: 0-8 (very light grey); Low: 8-16 (light grey); Medium: 16-24 (medium grey); High: 24-32 (dark grey); Very high: 32-43 (black).

Figura 5. Valoración de las zonas proveedoras según el SE identificado. Mapas: A) Agua para agricultura, industria y consumo humano; B) Representación estética, espiritual y de no-usos; C) Recreación y ecoturismo; D) Regulación de la erosión; E) Regulación de flujos hídricos; F) Regulación del ambiente biótico. Escala: Muy bajo: 0-8 (gris muy claro); Bajo: 8-16 (gris claro); Medio: 16-24 (gris medio); Alto: 24-32 (gris oscuro); Muy alto: 32-43 (negro).

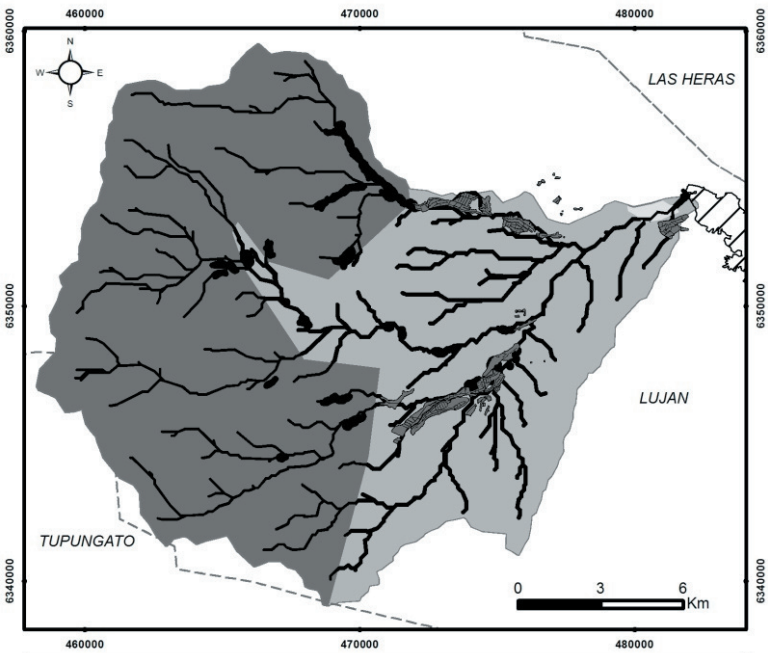

Figure 6. Priority sites for ES conservation in the Blanco River basin.

Figura 6. Sitios prioritarios para la conservación de SE en la cuenca del río Blanco.

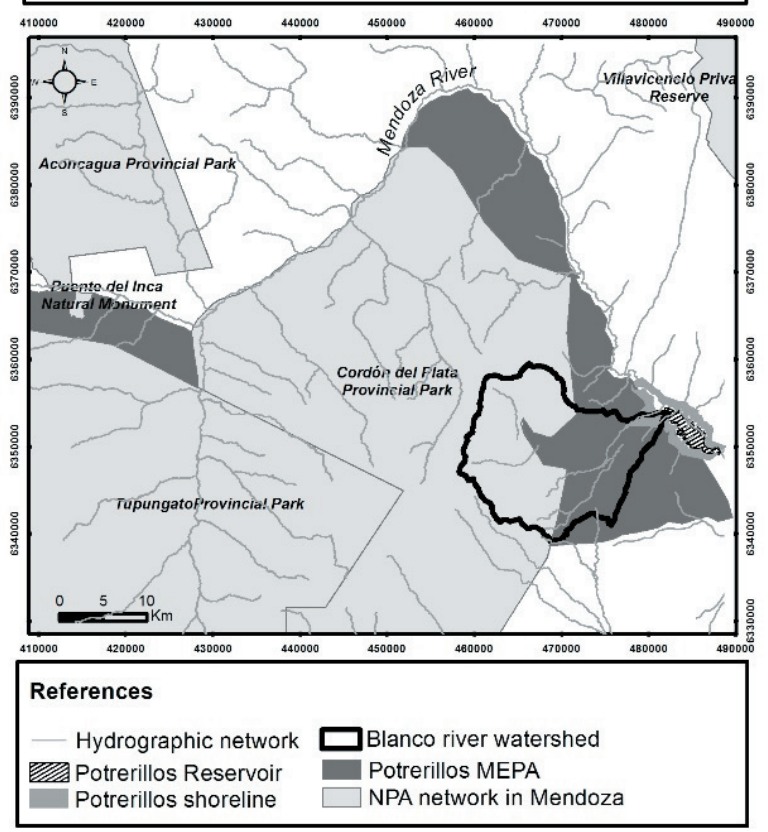

Figure 7. Geographic location of the Potrerillos MEPA and its conservation context. The created protected area gives spatial continuity to the conservation strategy of nature reserves in the Andean province of Mendoza: Tupungato Provincial Park, Aconcagua Provincial Park, Cordon del Plata Provincial Park, Inca Bridge Natural Monument and Private Villavicencio Natural Reserve.

Figura 7. Localización geográfica del AAMP Potrerillos y su contexto de conservación. El área protegida creada otorga continuidad espacial a la estrategia de conservación de reservas naturales altoandinas de la provincia de Mendoza: Parque Provincial Tupungato, Parque Provincial Aconcagua, Parque Provincial Cordón del Plata, Monumento Natural Puente de Inca y Reserva Provincial Villavicencio.

the scientific sector, management and civil society, which culminated in the creation of the protected area of Potrerillos MEPA. This point is one of its major strengths, for the consultation and diagnosis stages were met, the proposal was actually implemented, and the interests of all actors involved were integrated into public conservation policies. Also to be noted among the positive aspects of the experience, there is a strong articulation between the different social actors involved, which helped boost and collectively build the project for the protection of the basin's wetland system. A clear example of this is that the knowledge generated was a key input to the definition and creation of the Potrerillos MEPA. Furthermore, the results achieved with involvement of the population in different instances provided the basis for future viability of the protected area.

Among the weaknesses identified during the process, mention should be made of the lack of constancy of the basin's permanent and temporary residents to participate in all workshops, owing to the lengthy duration of the process. Despite they showed real willingness to participate, very few were involved throughout the whole process. Given this result, which demonstrates a weakness in the study design, it is possible to think that, should the experience be replicated, the process would have to be accomplished over a shorter timeframe. An additional weakness is that although the participatory process to design the NPA was directed toward an integrated protection of the priority systems defined (wetland system and watershed headwaters), it should be highlighted that the "size" factor prevailed in the political decision makers involved in the project. Because of them, other sectors were added to the collectively formulated design that focused on the Blanco River watershed (Pampa del Tabolango and the area adjoining the Puente del Inca NPA), which constitute discontinuous protected areas and are beyond the scope of the integrated watershed management proposed.

Discussion

Adopting the framework or socio-ecological systems (from stage 1 of the process) allowed a comprehensive approach to both, the major environmental issues affecting the area and the ES it provides. This framework is considered appropriate due to the close relationship between the social and natural systems, in a continuous process of transformation that extends over time (Martín-López et al. 2010). In the case of wetland systems, it enabled visualizing the existing relations of reciprocity between the biological-physical system (services and functions offered by the wetland) and the social system (ES users and beneficiaries) and, at the same time, their individual manner of functioning (Berkes and Folke 1998). In light of this approach, the participatory process of ES assessment consolidated the area's construction and favored identification of priority sites for conservation.

The collective process conducted, aimed at identifying and assessing the ES provided by the Blanco River watershed and at demarcating the NPA, is a clear example of incorporating social participation and political will as a key driving force in the creation of protected areas. Also, articulation between the different social sectors involved allowed achievement and validation of agreements, generating a positive synergy that translated into management actions and their subsequent impact upon the territory. With respect to the scientific sector, it is important to highlight that the knowledge generated transcended the level of research and was a key input to decision making.

Given the environmental issue raised, a priority criterion for designing public policies relative to land-use planning, tending to halt the degradation processes undergone by the wetlands, involves identification and participatory analysis of the services or benefits this kind of ecosystems provide, because of their contribution to human well-being (Fisher et al. 2009). In making territory decisions, it is essential to know the type of ES provided and their spatial expression; in this methodological context, the map becomes of vital importance (Nahuelhual et al. 2013).

It is also worthy of mention that the participatory proposal guiding the formulation of the project for the Potrerillos MEPA was based upon the principles of the Ecosystem Approach in terms of social participation in the decision-making process relative to the natural resources to be managed. In this regard, it must be considered that assessment depends on the interests and values of those who perform it (Costanza and Farber 2002), so it is necessary to promote the involvement of a greater number of stakeholders associated with the territory's dynamics. The collectively achieved

results were not only a source of consultation and opinion, but were also considered as valid an input as those contributed by the scientific or government sectors. It is for this reason that participation of the different sectors involved, which relate positively or negatively to the area's conservation values, either directly or indirectly, has been central in creating the protected area. This type of intersector and interdisciplinary work allows achieving the environmental management of the site by those involved in executing the proposal, namely the users of the Potrerillos MEPA.

As Daily et al. (2009) point out, it is necessary to design efficient and long-lasting tools that contemplate the services provided by ecosystems and the impacts they are subjected to. In this sense, it can be asserted that the key to the incorporation of the Potrerillos MEPA into the so called "paper" areas lies in the commitment and efforts made by the different sectors towards an effective management of the area, a task in which decision makers play a crucial role.

In light of the growth opportunities envisaged for the Potrerillos district, great inter-institutional challenges will have to be overcome for a successful management of the Potrerillos MEPA. Among them, consideration should be given to the issue of compatibilizing the mandates established in the Management Plan set up for the NPA with those defined in other instruments for land-use planning such as Municipal Plans for Land Management Planning and Special Plans, both anticipated by the Law on Land Management Planning of Mendoza province (Law No. 8051/09). In this context, articulation with the land-use zoning proposed by these instruments will be essential for promoting conservation of the environment under a sustainable development model, ensuring preservation of ecosystem services, such as water supply in drylands.

In synthesis, we can reflect on the whole process in terms of the strengths and weaknesses in the creation of the Potrerillos MEPA. As a special strength, we can highlight the fact that this creation initiative arises from a heterogeneous group of residents and users of the basin, concerned about the decline of their well-being owing to the impact caused by unplanned expansion of residential areas, real estate speculation and the explosion of visitors associated with the creation of the Potrerillos dam. This concern was attended to by the Municipality of Luján de Cuyo (the decision makers in the territory) which initiated the participatory process of creating the area. The first barrier identified is that decision makers involved in this proposal were career officials, but not leaders at political level. On account of this, the political leadership bodies were many times absent from the debate and only took part in institutionalizing the process, at the end of their electoral mandate. The renewal of municipal authorities caused a delay of at least four years in the implementation of the proposal. However, here again appears the strength of the participation of different actors in the process; the proposal was revived with great impulse just as the new mandate was started. The framework created by the new Law on Territory Planning of Mendoza province promoted the consolidation of these processes, taking advantage of these successful experiences, including lessons learned and potential to be replicated in the rest of the territory. At the same time, it adds value to decision making based on knowledge, and ensures that the guidelines obtained and the understanding of the ES provided by the basin can be managed through territory planning proposals towards sustainable use.

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