The benefits of natural areas on urban areas by recognizing the ecosystem services: a strategy to link the protection of natural areas to urban settings.

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Chilean Mediterranean ecosystems are widespread recognized by their biological diversity. Despite this importance, farming and urbanization activities, which are increasing since the late 20th century, have altered their structure and function. As a result, these ecosystems represent small areas isolated within a human-dominated landscape at present. One of the ecosystems that receive a higher pressure is the Andean piedmont area, a pre-mountain formation between 800 to 1,500 mals, including many ravines. The Andean piedmont is located next to Chile's capital city (Santiago), which concentrates higher population density and urbanized surface than other cities in Chile.

Chile has an official system to protect the ecosystems. However, its scarce representation in the Mediterranean region has not allowed an effective conservation strategy for these ecosystems. Parque Mahuida is not part of this system. It is an 112-ha periuban public park placed in the Andean piedmont. It is administered by a foundation, which has been created by the local government (district). This park contains remaining of Mediterranean vegetation including evergreen sclerophyllous shrubs and forest distributed mainly in ravines. Since the ravines have limited public access (mainly due to its topography), this type of vegetation has been partially conserved.

The accelerated urbanization rate of the administrative districts (with a high socioeconomic status) next to Parque Mahuida has increased the pressure in this area. In addition, non-controlled outdoor activities have promoted the degradation in some areas within the park. As a result, an urgent regulation frame has been recognized by the local government to be incorporated. Due to the closeness of the Parque Mahuida to urban areas, the environmental planning in the area must be supported with the acknowledgement of it as a semi-natural ecological system able to generate ecosystem services for the inhabitants living nearby. Incorporating these aspects in the environmental planning, would allow the managers to link natural conservation goals with social benefits for the surrounding population.

We developed the Parque Mahuida environmental plan with an approach based on the assessment and protection of the ecosystem services that are consumed by local inhabitants and those areas that producing them. Using the *Millenium Ecosystem Assessment* classification, we suggested that ecosystem services mainly consumed in Santiago's periurban parks would be "cultural services" and "regulating services". For the first, people can access into these places in order to use and enjoy the nature (even from remote districts). The second have expression both at local scale (e.g. water regulation) and at global scale (e.g. carbon sequestration). These are directly perceptible, quantifiable and are not an object-to-election. The urban areas that obtain benefits from these ecosystem services are spatially delimitable and are in function of its closeness to natural areas and the urban settings. Thus, these regulation ecosystem services are consumed outside the parks.

We have identified the park biophysical structure with emphasis in geomorphology by using a digital elevation model. We also identified the vegetation structure through the land vegetation cover, the dominant species association and the structural strata diversity. The areas with higher biomass concentration and slope classes were mapped. After that, we prioritized these areas to conserve the

production of three ecosystem services: 1- water regulation, 2- air quality maintenance and 3- local climate regulation.

The next step will be to explore the extension and form of urban areas that are favoured with these ecosystem services. For that, we will map these areas and will also identify the amount of inhabitants favoured by these services. In order to achieve this, a key factor will be to know how the ecosystem services are spread into the urban areas. This could be expressed in materials or energy flows. Theses flows will be conditioned by: 1- the ecosystem service maximum production in the natural area, 2- physical variables that facilitate or constrain the flows (e.g. slope and wind), 3- the urban settings that could facilitate or constrain the flow and, 4- others urban area characteristics (e.g. urbanization process and population density) that could affect the ecosystem services supply in some areas with high consumption rate.

Because the natural areas have a double function (global and local), who should plan and manage these areas? On one hand, global ecosystem services have a worldwide interest and international organizations are protecting them. On the other hand, local ecosystem services may be protected by local government institutions and the private agencies (e.g. real estate companies). This is particularly important for small and periurban natural areas, i.e. areas that are under pressure for land use change.

Although the nature does not distinguish the socio-economic status of the populations favoured by ecosystem services, it has different impacts on poor and rich populations. On one hand, the poor populations depend on the ecosystem services because they cannot substitute them for technologies. So, for poor populations, the lack of ecosystem services affects directly their well-being. On the other hand, the ecosystem services would have a less importance in higher socioeconomic status population because they can use human-made materials, heating or cooling systems and, water and air purifiers. However, the implementation of these "human services" can generate significant environmental impacts. Thus, the local government could be more appropriated to manage the ecosystem service supply through the management of periurban public parks, increasing its prioritization and influence in the decision making process. In rich population, could be the private sector instead, which is able to develop urbanization programs absorbing the adaptation costs and/or implementing actions in near public parks, as a result of the environmental impact assessment of new urban projects.

In both cases we propose for periurban parks: 1) to quantify the regulating ecosystem services production and the areas and inhabitants that are favoured with these services and; 2) the parks implementation, management and/or financing of periurban public parks have to be shared between public and private institutions, according to the socio-economic population status. This, in order to protect and maximize the ecosystem services production. This would have positive effects on the biodiversity conservation, representing an alternative way to protect natural areas near to cities. Traditionally, the main arguments to protect the natural areas are the endangered and uniqueness degree of biodiversity. Indeed, this new approach is based in the inhabitants' daily well-being who living next to these areas.
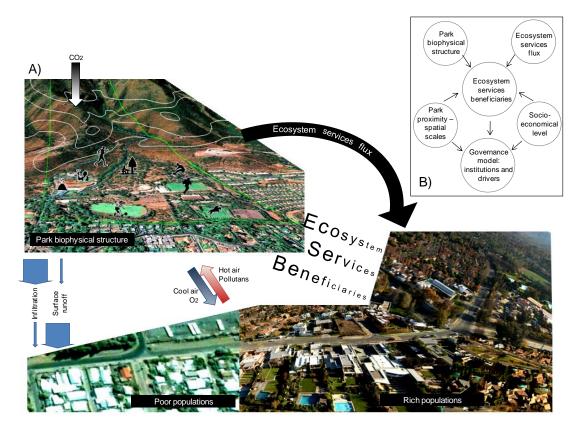
Figure: Relationship between ecosystem services production, social benefits and environmental management opportunities. A) Materials and energy flowing between periurban parks and surrounding urban areas. B) Conceptual model explaining how the dynamic of ecosystem and its components are linked to governance aspects.