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New Issues on Protected Area Management

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1. Introduction

Protected areas (PAs) are the main strategy to face the global deterioration of ecosystem goods and services due to human causes (Mora & Sale, 2011; Sanderson et al., 2002) and especially of biodiversity (Jenkins & Joppa, 2009; Pullin, 2002).

Almost 150 years have passed since the designation of the first "modern" PAs, back in the XIXth century. Designation of PAs has growth rapidly since that date and especially since the last third of the XXth century (Jenkins & Joppa, 2009; McDonald & Boucher, 2011). Currently, there are over 120,000 nationally and internationally-designated PAs in virtually all the countries of the world (UNEP-WCMC, 2008). They covered about 31.235.000 km², over 21% of the global terrestrial (approximately 17,290,000 km²) and ice-covered area (some 13,950,000 km²) by 2010, according to the Wold Database on Protected Areas (WDPA), and continue to expand. Conservation has become one of the main land uses globally, with approximately 13% of land under some form of protection (Jenkins & Joppa, 2009; McDonald & Boucher, 2011). Vast human, material and economic resources are allocated to conserve and use sustainably the natural and cultural resources provided by PAs. And yet biodiversity and the other ecosystem goods and services continue to be lost (Butchart et al., 2010). As a result, PA management is receiving increasing attention as one of the key aspects for the effective conservation of PAs.

In this chapter, different aspects related to PA management are discussed. It also tries to clarify some controversial concepts and to encourage the discussion on a number of challenging issues of interest for scientists, managers, policy-makers and conservationists.

2. Definition of protected areas

There are two internationally accepted definitions of PA: the definition given by the Convention on Biological Diversity (CBD, 1992), and the latest definition proposed by the IUCN (Dudley, 2008). Both have subtle conceptual differences that should be scrutinized in detail to know what exactly is being talked about:

a. According to the CBD, a protected area is "a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives" (CBD, 1992). This broad definition could apply to virtually every space with some regulation to achieve proper use and conservation of resources, such as game reserves, managed logging areas, marine reserves, or Biosphere Reserves, for instance. No specific mention to the conservation of biological features is given. As a result, this definition could also apply to non-biological resources meriting conservation, such as physical, geo-morphological or even cultural features, like museums or cathedrals.

b. According to the most updated definition of PAs by the IUCN, a PA is "is a clearly defined geographical space, recognised, 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). This definition is more precise, and includes three key and advanced conservation concepts: 1) the "long-term" scope of conservation; 2) the specific conservation of "nature"; and 3) the conservation of complementary ecosystem and cultural goods and services.

All six (seven?) PA management categories proposed by the IUCN (Dudley, 2008) share the principles included in this definition. This second definition of PA is more accurate and thus it will be used along this chapter.

3. Multiple use. Sustainable development in protected areas?

Currently, almost no one argues that the overarching goal of PAs is conserving biodiversity and that any other management objective should be subject to biodiversity maintenance, improvement or restoration (Múgica & Gómez-Limón, 2002). There is, however, considerable debate on the weight of additional social and economic objectives in PA management, following the desirable yet vague concept of sustainable development (WCED, 1987).

Global agreements are giving PAs a starring role in many aspects other than biodiversity conservation. One extended mission included in its most updated definition is providing while preserving ecosystem goods and services and associated cultural features other than biodiversity. The most relevant goods and services provided by PAs include: raw materials, food, genetic, medicinal and ornamental resources, water purification, air quality regulation, erosion prevention, mitigation of extreme events, pollination, biological control, carbon sequestration, soil formation, primary production, and nutrient cycling (Chape et al., 2008; Millenium Ecosystem Assessment [MEA], 2005; Naughton-Treves et al., 2005). Lately, PAs are also increasingly conceived as optimum testing fields for monitoring global change (Alcaraz-Segura et al., 2009), as well as useful and cost-effective means for climate change adaptation and mitigation (Dudley et al., 2010). As seen, the "environmental targets" of PAs are quite ambitious. Not all PAs are able to provide all those goods and services, although some of them, especially the biggest ones, might.

Nevertheless, following the dominant tri- (or four-) dimensional concept of sustainability (Spangenberg, 2002), PAs are also entrusted a high number of other social and economic

roles, multiplying management objectives virtually to the infinite. Some of those roles are: scientific research, recreation and tourism, inspiration for art and culture, spiritual and cognitive development, aesthetic enjoyment, preservation of traditional cultures and practices, improving social welfare, enhancing environmental education and awareness, promoting peace and security, facilitating people's participation and governance, and boosting economic development at multiple scales (Chape et al., 2008; Naughton-Treves et al., 2005).

Whereas attaining all those targets would be ideal for any PA, the challenge for PAs to do so is overwhelming. These goals are so wide and ambitious that, even in the cases where they are not directly opposed (UNESCO, 2002), it looks doubtful that any piece of land in the world could comply harmoniously with all of them.

Acknowledging the role of man within nature and its importance for the conservation of many species, habitats and ecological processes, especially in Europe where cultural landscapes are paramount (Jongman, 2002), multiple use of PAs sometimes becomes a "dogma" for PA planners, managers and policy-makers, irrespective of very different conditions and situations. Most conservation policies try to force sustainable development to happen, often through the zoning of PAs (Naughton-Treves *et al.*, 2005; UNESCO, 2002) or the placing of tourist infrastructures (Farrell & Marion, 2001), regardless of the fact that some activities may conflict with conservational ends. Such conflicts are frequent in densely populated areas between conservation and recreation activities (Tisdell, 2001).

Figure 1. Cultural features and traditions are an important and often neglected asset of protected areas

Cultural, recreational, educational and economic values should be pursued in PA planning and management, as long as the key aim of PAs (*i.e.*, conserving biodiversity) is never left behind to satisfy other possibly conflicting objectives. If social and economic objectives are compatible with biodiversity conservation or improvement, we should try to integrate those within planning and management. If they are not, their practice attainment should be

considered no more than theoretical goodwill, no matter how temping development promises may look like. If poorly conceived, executed and regulated, even the best socioeconomic proposal might turn out to be the deadliest ecological error (Witte et al., 1991).

Therefore, predicted future trends on the prevailing designation of "multiple use" PAs (IUCN categories V and VI) in the years to come (McDonald & Boucher, 2011), although a good piece of news in itself, might entail subtle risks for effective conservation of resources.

The best solution to make most uses of PAs compatible would be designing a territorial model made of different types (regarding their priority function) of large, zoned PAs connected through biodiversity-oriented managed landscapes (Mata et al., 2009; Rodríguez-Rodríguez, 2012b). However, limited resources and high land and visitor pressure, especially in densely populated areas, force us to put the preservation of ecosystem processes first and before any other use or consideration of PAs (Pressey *et al.*, 2007).

4. The role of tourism in protected areas

Tourism is an extremely delicate issue regarding PA management. Whereas often seen and promoted as social and economic salvation for local communities, if unregulated it may, on the one hand, lead to the deterioration or destruction of the resources of the PA and, on the other, threaten local culture. If well planned and managed, however, tourism can provide a significant source of revenue for local populations and / or PA administrators, as well as increase visitor education and environmental awareness (Chape et al., 2008).

Figure 2. Visitors may be an intense pressure in protected areas

Nevertheless, management and conservation problems are intrinsic to tourist visitation of PAs. These include: increasing use of resources, including land-use changes for developing tourism infrastructures in or around PAs; soil trampling and compacting; vegetation

removal; animal disturbance; soil erosion; littering; noise making; introduction of alien species and varieties; damage to geological features, cultural sites, vegetation or public use infrastructure; increased fire risk; air pollution from transportation; animal road killing; changes in wildlife behavioural patterns due to human habituation, among others impacts (Chape et al., 2008; Farrell, 2002). Some of these impacts can be so serious that they can compromise the long-term conservation of the resources being protected (Barrado, 1999; Rodríguez-Rodríguez, 2009; Tisdell, 2001). Visitor impacts may also result in a reduced quality of recreational experiences and in conflicts among visitors (Farrell 2002; Phillips, 2000).

Additionally, public use management competes for scarce funding with other management and conservation objectives of PAs, as it is a highly resource-demanding activity (VVAA, 2000).

While zoning PAs and building tourist infrastructure might be useful at reducing impacts from tourism in PAs by directing main fluxes towards the least fragile zones of the PA (Farrell, 2002; UNESCO, 2002), they cannot usually prevent invasion of more vulnerable zones (Barrado, 1999). In fact, tourism infrastructure can attract even more visitors to the PA, and may result in its overcrowding and collapse (Morales, 2001).

As a result, although public use in PAs is a desirable and broadly-accepted concept, it should be strictly regulated or even prohibited in the cases when it is incompatible with conservation targets which must prevail in PAs.

5. Free access to protected areas? Financial and equity aspects of entrance fees to protected areas

As we just saw[1], impacts of visitation to PAs are numerous and serious (Chape et al., 2008; Rodríguez-Rodríguez, 2009). Whereas there is free access to most PAs in industrialised countries, no matter what land ownership is, entrance fees are common practise in other parts of the world (Emerton et al., 2006).

There are a number of reasons in favour of charging a fee for accessing PAs. First and most important, entrance fees are effective visitor filters (Emerton et al., 2006). On the one hand, they enhance the quality of visitors by discouraging the least interested visitors often having the poorest environmental awareness (Barrado, 1999) from entering the PA, thus helping prevent most unsocial behaviour (McKercher & Weber, 2008). On the other, they potentially reduce the quantity of visitors, thus diminishing the human pressure on species, soil, vegetation, ecosystems, cultural features and infrastructure (Rodríguez-Rodríguez, 2009).

The second reason, as seen at the beginning of this chapter, is that PAs provide multiple social goods and services related to improved health and well-being: recreation, tourism, sport, relax, inspiration, cultural and aesthetic enjoyment, and spiritual and cognitive development (Chape et al., 2008). The fact that most of these goods and services have not

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[1] See heading 4

market price does not mean their economic value is negligible; rather on the contrary (Emerton et al., 2006; Kerry et al., 2003). Thus, charging an amount of money to enjoy all these benefits from PAs does not seem exaggerate.

Additionally, paying an amount of money makes the visitor conscious of the value of the visited place (Emerton et al., 2006). It gives him also a temporal "membership" to a "selected" group of people (club) with the right to respectfully enjoy the wonders of the PA.

Finally, most PAs are underfunded (Leverington et al., 2010; Nolte et al., 2010) and budgetary restrictions will tend to be the rule more than the exception in the future due to financial constraints in the public sector which currently makes up most PA funding globally (Phillips, 2000). Thus, provided that incomes from visitors are properly invested in PAs (in the same PA they are expended or in other PAs to support underfinanced or undervisited PAs), PA administrators could count on an additional source of financing to enhance management and conservation and to provide new employment opportunities (Emerton et al., 2006; Phillips, 2000).

Fee collection should be carefully planned and implemented. It must consider adequate equity prior to its implementation so none will be deprived of his or her right to enjoy PAs. Thus, discounts should be applied to low-income visitors upon appropriate certification. Dual-pricing policies charging foreign visitors higher than local ones are an equitable and socially acceptable option in developing countries (Walpole et al., 2001).

Well-thought decisions should also be taken about visitors being charged repeatedly during their visits (for instance, for car parking, access to the PA, and / or visitation of public use infrastructure), and about the appropriate quantities to be charged in view of recovery costs, so no additional charges are imposed to the PA administration (Chape et al., 2008).

Figure 3. Parking fee in Peñalara Natural Park, Madrid Region, Spain

6. Effective management vs. effective conservation

There is not consensus on the effectiveness of PAs as a global strategy for biodiversity conservation. There are examples of conservation success and failure, although the latest are rarely reported (Mora & Sale, 2011). Lack of or inappropriate monitoring and assessment activities are common management deficiencies (Leverington et al., 2010) making the assessment of PAs often difficult, arbitrary or meaningless (Parrish et al., 2003).

Therefore, whereas the protection of spaces for biodiversity conservation remains a valid and useful strategy to mitigate current environmental crisis, a general statement in favour of the actual effectiveness of PAs as a tool for biodiversity conservation is simplistic. Rather, PA effectiveness should be analysed case by case[2].

It is generally accepted that legal designation plus effective management result in the effective conservation of PAs (Hockings et al., 2006). It is not always the case, however. There are important pressures and threats to the conservation of PAs and their resources that operate at a scale broader than PAs and that may, therefore, spoil brilliant management efforts, as they are outside the scope, means and competence of PA managers (Alcaraz-Segura et al., 2009; Jameson et al., 2002; Parrish et al., 2003).

Impacts of global change are posing additional pressures on the conservation of biodiversity worldwide (Araújo et al., 2011). Regional impacts can also cause severe effects on faraway zones regardless of their degree of protection or management effectiveness. Acid rain on land and oil spills on sea are good examples. As a result, a PA can be legally designated, well-planned and efficiently managed and see its resources being degraded (Mora & Sale, 2011), more so in the marine environment where connectivity is higher than on land (Jameson et al., 2002).

PAs exchange matter, energy and information with their surroundings. These exchanges are vital to ecological processes underpinning biodiversity and other ecosystem goods and services (Múgica et al., 2002). Shifts in nature, extent, direction and intensity of these interactions may also, however, result in significant alteration of the ecosystem structure and function, even if optimum PA management is in place. Therefore, PAs cannot be managed in isolation from the surroundings influencing those (Radeloff et al., 2010). As a result, nearly as much care should be taken when managing zones surrounding PAs as when managing PAs themselves.

Effective management can play an important role in PA conservation. It can also contribute to adaptation and mitigation of some regional or global pressures and threats, such as climate change, through PAs (Dudley et al., 2010). However, the role of management in attaining long-term conservation of resources should not be overemphasized. PA managers can very rarely achieve effective conservation of managed sites on their own. In contrast, the importance of achieving sustainable development at all scales, integrating PAs in a wise and wider territorial planning (Rodríguez-Rodríguez, 2012b) cannot be stressed enough.

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[2] See heading 7

7. Assessing protected areas. Scales and perspectives

For too many years, it was assumed that the resources harboured by PAs were effectively conserved just because they were legally protected. Regrettably, empirical and scientific evidences refute the previous assumption (Butchart et al., 2010). Luckily, that vision is currently outdated and much literature has been written on "paper parks", although they still prevail in certain contexts (Bonham et al., 2008; Davis, 2001).

Currently, the question is: what should be assessed? Or: how to measure PA effectiveness?

Multivariate, socio-ecological systems such as PAs are difficult, costly and time-consuming to characterize, monitor and assess. Lack of basic knowledge increases the uncertainty of what to monitor, how and why (Parrish et al., 2003).

As a result, developing a complete, ecologically-sound and meaningful-for-management assessment system has proved extremely complicated, despite several efforts developed worldwide: Hockings et al. (2000; 2006); Ervin (2003a), Parrish et al. (2003), Pomeroy et al. (2005), Gaston et al. (2006); Mallarach et al. (2008); Ioja et al. (2010); Rodríguez-Rodríguez & Martínez-Vega (in press).

To start untangling this issue, a distinction between different concepts which are often used indiscriminately (Ervin, 2003b) should be made. One is "management effectiveness" and the other is "PA effectiveness". Identifying both concepts would be the same as saying that all a PA can do to protect and conserve its resources is due to management. Once more, evidence does not seem to support this statement (Jameson et al., 2002; Mora & Sale, 2011), as we just saw[3].

There are unprotected places well conserved due to lack of human visitation, accessibility and exploitation (Sanderson et al., 2002). There are paper parks enjoying a good conservation status for similar reasons. And there are legally-designated, well-managed PAs being degraded due to unsustainable socioeconomic contexts and / or regional or global pressures and threats (Jameson et al., 2002; Radeloff et al., 2010).

Thus, PA effectiveness is not the same as management effectiveness. Stating so would put all the responsibility for the conservation status of PAs on managers with limited means, capacity and competences to cope with many factors outside their control. Thus, on the one hand, this identification is not precise and, on the other, it may neither be fair to PA managers (Rodríguez-Rodríguez & Martínez-Vega, in press).

Additionally, according to the "Management Effectiveness Evaluation Framework" (Hockings et al., 2000, 2006), protected area management effectiveness evaluation (PAME) should be target-driven. Therefore, if considered precisely, PAME could not be applied to most PAs worldwide lacking specific, clear, mensurable management objectives (Bertzky & Stoll-Kleemann, 2009; Pomeroy et al., 2005).

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[3] See heading 6

Therefore, "management effectiveness", which is an important part of "PA effectiveness", should only deal with factors directly linked to management which managers can control and address with sufficient knowledge, capacity and resources, while leaving out context variables they cannot manage or even influence.

There are different conceptions of "PA effectiveness": from its identification with "management effectiveness" (Hockings et al., 2000; Ervin, 2003a; Hockings et al., 2006), to "ecological effectiveness" (Gaston et al., 2006), "ecological integrity" (Parrish et al., 2003), or "sustainability"[4] (Rodríguez-Rodríguez & Martínez-Vega, in press).

Language precision is fundamental in science, but so far none has come up with an ideal, agreed term to designate overall "PA effectiveness" despite the wide literature on the topic: are we measuring effectiveness?, performance?, functionality?, conservation potential?, sustainability?, success?, ecological integrity?, accomplishment? This uncertainty is because the core object being assessed is complex and integrates several different parameters (often environmental and also social and economic) not easily defined in one known-term.

A second question arises that further highlights the complexity of assessing PAs in an integrated and scientific manner: is "effectiveness" a common, "objective" concept? Is it site-specific and thus, "subjective"? Or can it be both? The answer is not straightforward. There are different perspectives on PA effectiveness assessment closely linked to the scales considered and the objectives pursued with the assessment.

Scales are important when defining PA effectiveness. For example, "management effectiveness", "ecological effectiveness" and "ecological integrity" are usually conceived as "site-specific" due to the different ecological conditions, contexts and, therefore, management needs and objectives of every PA (Hockings et al., 2006). In contrast, "sustainability assessment" proposes a common assessment and valuation method for PAs belonging to the same context (administrative, bio-geographical, or socioeconomic). Based on the most updated definition of PA (Dudley, 2008), it assesses the likelihood that a PA can conserve its natural and associated cultural resources and ecosystem services in the long-term on relevant common parameters for management and decision-making. It is also a site assessment, but it allows comparison and prioritization among the individual PAs assessed as assessment is made upon the same parameters (Rodríguez-Rodríguez & Martínez-Vega, in press).

At a broader scale, the effectiveness of conservation networks should also be assessed using landscape metrics and indicators (Burel & Baudry, 2003).

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[4] In our preliminary work (Rodríguez-Rodríguez & Martínez-Vega, in press), we identified "environmental" or "hard" "sustainability" as the core concept to be assessed when evaluating PAs, according to the goal of long-term conservation of natural and cultural resources established in the latest definition of PAs by the IUCN (Dudley, 2008) and in the original definition of sustainable development (WCED, 1987). However, some colleagues were reluctant to the use and formalization of the term "sustainability" as a result of the vagueness of its original definition and its different interpretations, so we changed the term to "PA effectiveness", also meaning the PA capacity or potential to conserve its resources in the long-term. Nevertheless, we think "sustainability" is a valid focus for assessing PAs with no more difficulties in its definition and formalization than any other complex integrated concept such as "effectiveness".

Table 1 summarizes the different complementary approaches to assessing PA effectiveness.

Assessment	Scale	Object	*Main* target group
Ecological effectiveness	Individual PA (Site-specific)	Ecological parameters: ecosystems, species and the physical-chemical environment	*Scientists*; PA managers
Ecological Integrity	Individual PA (Site-specific)	Threats; Focal species, communities and ecological systems	*PA managers*; decision-makers
Management effectiveness	Individual PA (Site-specific; Comparable)	Management goals, objectives and strategies regarding: context, planning, inputs, processes, outputs & outcomes	*PA managers*; PA network managers; decision-makers
Sustainability / Effectiveness	Individual PA (Comparable)	State of conservation, planning, management, social and economic context, social perception and valuation, and threats to PAs	*PA network managers*; PA managers; decision-makers
PA network	Landscape; territory	Connectivity, biodiversity representativeness, gap analysis, etc.	*PA network managers*; decision-makers; territorial planners

Table 1. Complementary approaches to assessing protected area effectiveness

8. Protected area objectives vis à vis management objectives

Clear objectives are fundamental for adaptive management and, therefore, for effective PA conservation (Hockings et al., 2006; Pomeroy et al., 2005). Nevertheless, it is rare that clearly-stated, science-based objectives be specified in any PA norm or management document (Bertzky & Stoll-Kleemann, 2009; Pomeroy et al., 2005) and, when management objectives are set up, they are often vague, inadequate or even contradictory (Naughton-Treves et al., 2005).

Thus, the establishment of clearly-defined objectives at different levels in the long, medium and short-terms remains one the most urgent needs for effective management and conservation of PAs.

PA objectives should be initially specified in the designation norm of each PA, according to its conservation and management characteristics. Although these objectives might change in the medium-term due to the evolution of natural systems, they are mostly stable throughout the time, as they portrait a long-term vision of the PA. They can be similar to or adapted from the general objectives of the different PA management categories proposed by the IUCN (Dudley, 2008).

In contrast with these long-term "stable" objectives, medium-term specific objectives should be developed for each management planning period; *i.e.*, the validity period of an average management plan of 4-10 years (Thomas & Middleton, 2003). These medium-term planning objectives should try to make the long-term objectives of the PA happen considering the different circumstances of the PA throughout the time.

Finally, management plans are often disaggregated into more operational annual work-plans, whereby the medium-term objectives are made specific to the management means and to the reality of the PA through achievable and measurable short-term objectives (Thomas & Middleton, 2003). These short-term management objectives should also foresee (regarding means and probabilities of occurrence) and address sudden events not previously planned against which rapid action is required (Chape et al., 2008).

Figure 1 shows the conceptualization of the different types of objectives in PAs and their main characteristics.

Sensible objective definition leads to adequate planning and, if adequate means are available, to proper management of the PA. However, clear definition and precise forms of measurement of the different objectives are needed at all levels for management planning to be fully effective (Thomas & Middleton, 2003).
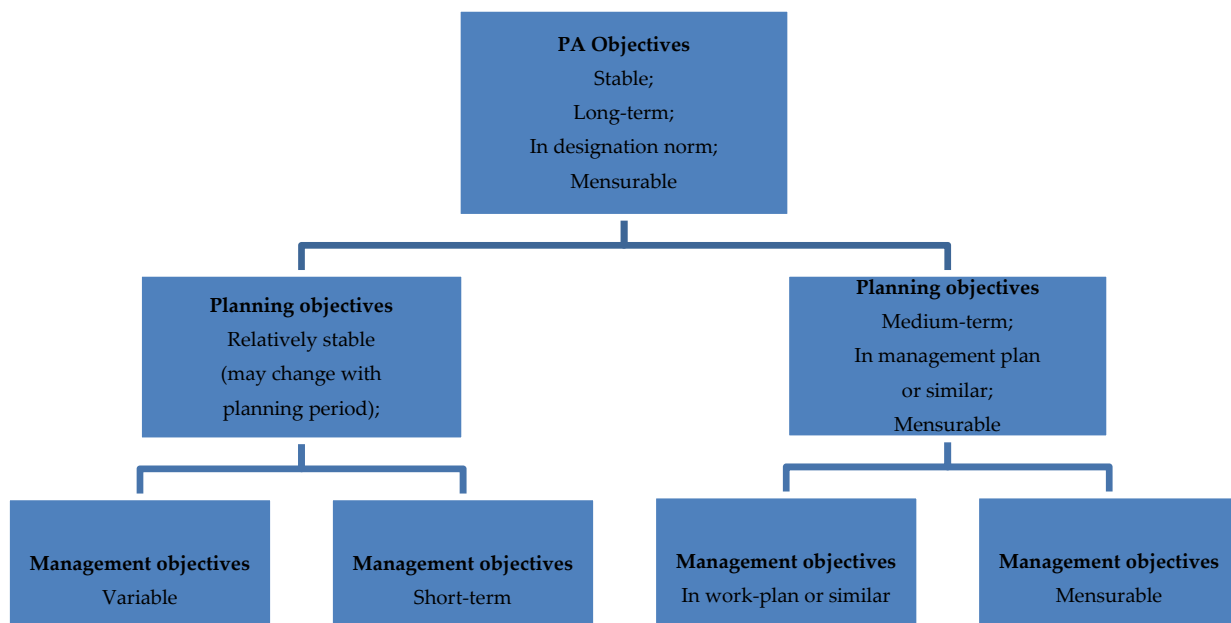
Figure 4. Outline of the different levels and objectives of PAs and their main characteristics.

9. The role of society in protected area management

PAs are portions of territory where multiple interests coexist and often collide (McKercher & Weber, 2010; Phillips, 2000). Although their main aim is to conserve biodiversity and the other ecosystem goods and services and associated cultural features, they include other environmental, social, economic and governance factors deserving attention. As such, they cannot and should not be managed in a unidirectional manner.

Neither decision-makers nor PA managers can cope with current challenges to PAs alone. An increasingly complex world requires increasingly innovative solutions, also regarding PA management. Thus, they should look for allies in other stakeholders if effective management and affordable enforcement is to be achieved.

Bottom-up, participatory approaches to PA management may be more resource and time-consuming than technical top-down approaches, but they are generally accepted better by all stakeholders and, as a result, they are often more effective and enduring. Consensus results in decisions being more legitimate, and in fewer conflicts (Fraser et al., 2006).

There are two priority groups whose close collaboration should actively be sought: scientists and local populations. Management measures can be more efficient, cost-effective and easily-implemented if they are based on sound science (Chape et al., 2008). Therefore, a stronger, deeper and more trustful relationship between PA managers and scientists is the first priority to enhance effective, participatory management (Zamora, 2010).

Local populations are also key to effective management (Rodríguez-Rodríguez, 2012a). Their views and attitudes towards PAs and their management can determine the success of most management initiatives (Múgica & Gómez-Limón, 2002; Borrini-Feyerabend et al., 2004).

Building a positive attitude towards PAs by local populations consists not only in informing individuals or associations (NGOs, neighbours, etc.) on management issues, but also in consulting them, making joint decisions and seeking their input to actually carry out some management activities (Múgica & Gómez-Limón, 2002). Environmental volunteering can be a very adequate way of participation of local populations into management, and also an effective means of reinforcing the identity of residents with the values, resources and governance of the PA.

Other relevant stakeholders to be considered in PA management are businessmen, politicians and tourists. New opportunities for business and employment related to the PA should be sought, mainly among local enterprises, as long as no negative impacts on the PA or its resources are guaranteed (Phillips, 2000). Therefore, economic activities affecting the PA should be carefully evaluated, planned and regulated in the management plan of each PA. Synergies among business, conservation and management practices should be potentiated; for instance, grazing in grasslands may have better ecological effects on biodiversity when complementing mowing than mowing alone (Metera et al., 2010). Thus, farmers can get free fodder for their animals and make profit by selling farm products associated with the PA, whereas PA managers can save money in ecosystem management.

Politicians should also be incorporated to valuating and managing PAs more actively. Their decisions can determine the future of a PA, including permission for aggressive activities within PAs or their surroundings, diminution or even disappearance of the protection status of a PA. Thus, they should be made aware on the importance of PAs and of their decisions for biodiversity and humans in the long-term. Social groups such as managers, scientists, local populations and NGOs can play an important role in lobbying for the cause of PAs.

Similarly, tourists should be made fully aware of their potential impacts on visited PAs (Hillery et al., 2001) through environmental education and volunteering, and public use infrastructure. Their collaboration with managers should be sought to obtain proper behaviour from them and, where possible, funding for the PA (Rodríguez-Rodríguez, 2012a).

10. Keeping pace with science

PA knowledge and management do not run at the same speed (Nolte et al., 2010; Pullin, 2002). Communication and trust between scientists and managers can also be much improved (Zamora, 2010). As a result, it is rare that sound, updated science be incorporated by managers and decision-makers and applied in everyday management (Pressey et al., 2007). Therefore, common management practices are frequently based just on experience, habit, or at best, on partial scientific knowledge (Pullin, 2002).

Sometimes, lack of scientific knowledge is due to overwork by managers. Too much field and / or administrative work leave them with little or no time or will to get updated on new management issues regularly (Pullin, 2002). Lack of adequate funding, interest or training programmes can also erode appropriate scientific knowledge among managers. Thus, staff training is an overall need in many countries (Leverington et al., 2010; Nolte et al., 2010).

And yet widespread updated scientific knowledge is vital for management and conservation effectiveness (Pressey et al., 2007). Resources devoted to conservation could be more successfully and wisely used if management practices were backed up by sound science (Pullin, 2002). Staff training should be considered an integral part of the management cycle (Kopylova & Danilina, 2011).

However, knowledge-transfer should not be unidirectional, from scientists to managers. The publication or communication of empirical management result and practices, be they successful or a failure, is also very important for advancing towards a more effective management of PAs and can provide science with interesting new research topics and experiences.

Figure 5. Presentations and workshops are useful training options

In conclusion, regular collaboration among scientists, managers and decision-makers is key for effective and efficient management (Pullin, 2002; Rodríguez-Rodríguez & Martínez-Vega, in press). Current disconnection and suspicion should be overcome if more effective ways of conserving PA are to be sought. This collaboration can take the form of regular working-groups or workshops. Ideally, researchers should be incorporated to the regular PA managing staff (Chape et al., 2008), be them restricted to specific PAs, covering a network of PAs, or both. Thus, actual management activities should be done considering both, sound science and best practice.

11. Rethinking protection scales: from protected areas to protected territories

Current *in situ* strategies for biodiversity conservation are not having enough success to stop or reverse biodiversity loss (Butchart et al., 2010; Mora & Sale, 2011), and thus biodiversity and the other ecosystem goods and services continue to be degraded (MEA, 2005).

Most PAs, especially in Europe, are too small to maintain viable populations within their boundaries in the long-term (Pullin, 2002). Under these circumstances, connectivity among PAs becomes fundamental (Jongman, 2002).

Ecological networks are a conceptual and practical step forward with regard to the initial concept of PA as islands in the territory. However, ecological networks are not without theoretical and practical shortcomings (Boitani et al., 2007). In addition, the current drivers causing environmental degradation are so intense than even ecological networks have been overcome by reality.

Enhanced connectivity of PAs through ecological corridors is thought to have increased PA conservation effectiveness (Beier & Noss, 1998). However, the wide range of scales taking part in ecological processes underpinning ecosystem goods and services (Pressey et al., 2007) make ecological corridors only partially effective, and only under some circumstances (Brunckhorst, 2000; Tzoulas et al., 2007). Moreover, the zones surrounding PAs are becoming increasingly artificial as a result of human activities and are therefore not accomplishing properly their buffer target (Radeloff et al, 2010). As a result, the effective protection and wise management of whole landscapes/seascapes surrounding PAs can be as important as the protection and management of PAs themselves (Jameson et al., 2002).

There is a growing consensus that effective biodiversity conservation cannot take place if complementary conservation scales broader than PA scale are not considered (Mata et al., 2009; Mora & Sale, 2011; Múgica et al., 2002; Rodríguez-Rodríguez, 2012b). Going from connected islands to connected landscapes is a desirable first step.

National conservation policies must be integrated and coordinated in order to be fully effective. The protection and management of isolated PAs, ecological networks or whole landscapes/seascapes alone is not sufficient for long-term conservation. Additional public conservation policies, mainly related to territorial planning, ecological restoration and

environmental impact assessment (of projects, policies, plans and programmes), should complement the establishment and maintenance of PAs at the national level.

Full consideration of ecological processes should also be carefully considered and integrated in other public policies seriously affecting the steady provision of ecosystem goods and services such as housing, mining, fishing, transport or industry. Ecological considerations should always guide (and limit, when necessary) social and economic development policies and strategies if sustainable development is to be achieved (Naredo & Frías, 2005).

However, no matter how effective a national conservation policy is, its effectiveness will always be limited by regional or global trends, making local or national efforts only partially successful (Mora & Sale, 2011).

Future conservation strategies should be regional and global, as the driving forces pressing biodiversity are. Ecologically, it makes little sense planning and managing PAs restricted to local or national administrative boundaries. Thus, deeper and closer international collaboration is needed when planning for conservation.

Focus should change from PAs to protected territories of high conservation value following science-based criteria: species richness, diversity, taxonomic uniqueness, degree of threat, endemism, unusual ecological or evolutionary phenomena, or notable provision of ecosystem goods and services (Pullin, 2002). The ecorregional approach proposed by Olson et al. (2001) seems a promising and adequate scale to plan and manage conservation from an ecological perspective. This is the conservation approach followed by relevant conservation organizations, such as the Nature Conservancy (TNC, 2001).

Management should be much more collaborative and imply different stakeholders from different sovereign authorities. This form of closer international cooperation can have positive impacts in other public policies such as human development or defence (Sandwith et al., 2001).

Even if conservation and management strategies become global and effective, they will only be a limited solution to current and increasingly unsustainable human development trends (Millenium Ecosystem Assessment [MEA], 2005; Sanderson et al., 2002). Thus, if an enduring solution to the environmental crisis (and thus, sustainable development) is to be achieved, global determined and courageous measures must be taken in order to counter current population, development and consumption trends (Mora & Sale, 2011). All public policies must take into account the bio-physical limits of the Biosphere and they should be planned and implemented accordingly, considering the long-term consequences of today's decisions.

12. Final remarks: managing the Biosphere for conservation

The astonishing variety of life on Earth and other vital ecosystem goods and services are severely threatened by human activities well beyond the capacity and competence of PA managers, PA network managers or even decision-makers.

PAs are just part of the solution to the environmental crisis. We should not be excessively optimistic about their ultimate outcome as the main biodiversity conservation strategy. They are a shock therapy for a patient who is turning rapidly to worst.

In situ conservation strategies failed by protecting only some areas on diverse criteria, and leaving the rest of the territory without any form of development control or regulation. We should change (have changed, long ago) our way of thinking and practicing conservation. Conservation should be global, literally. I mean that the entire Biosphere should be protected and, where necessary, appropriately managed, leaving only a number of places of extraordinary social and economic value out of protection for intensive development and human activities, such as mines, cities, transportation corridors, some croplands and plantations.

Some may think this is asking too much, but all signs point to the fact that we are heading towards an unmanageable disaster by surpassing vital ecosystem thresholds (Butchart et al., 2010; MEA, 2005; Sanderson et al., 2002), and that we are running out of time to change our ways. Even the most energetic global initiatives taken today might not be sufficient to prevent the notable impoverishment and eventual collapse of life on Earth.

13. Case study: Management assessment of the protected areas of the Autonomous Region of Madrid, Spain

From 2008 to 2011, we developed the System for the Integrated Assessment of Protected Areas (SIAPA) in the Institute of Economics, Geography and Demography of the Spanish National Research Council (Rodríguez-Rodríguez & Martínez-Vega, in press). We applied the SIAPA to the ten PAs of a paradigmatically unsustainable region: the Autonomous Region of Madrid, Spain (Jiménez et al., 2005). In this epigraph, we show the part of the study's results of the implementation of the SIAPA (Rodríguez-Rodríguez & Martínez-Vega, under review) dealing with management of the ten PAs assessed.

The Autonomous Region of Madrid is a Spanish region of slightly over 8,000 km² in the centre of Spain (Figure 6). It has the highest per-capita income in Spain. It also has a rich natural and cultural patrimony that is jeopardized by the implementation of an intensive resource-consuming development model (Mata et al., 2009; Naredo & Frías, 2005), which has led to an increase in economic standards, but also to massive residential and infrastructure developments throughout the region in the past 20 years (Fernández-Muñoz, 2008; Gago et al., 2004).
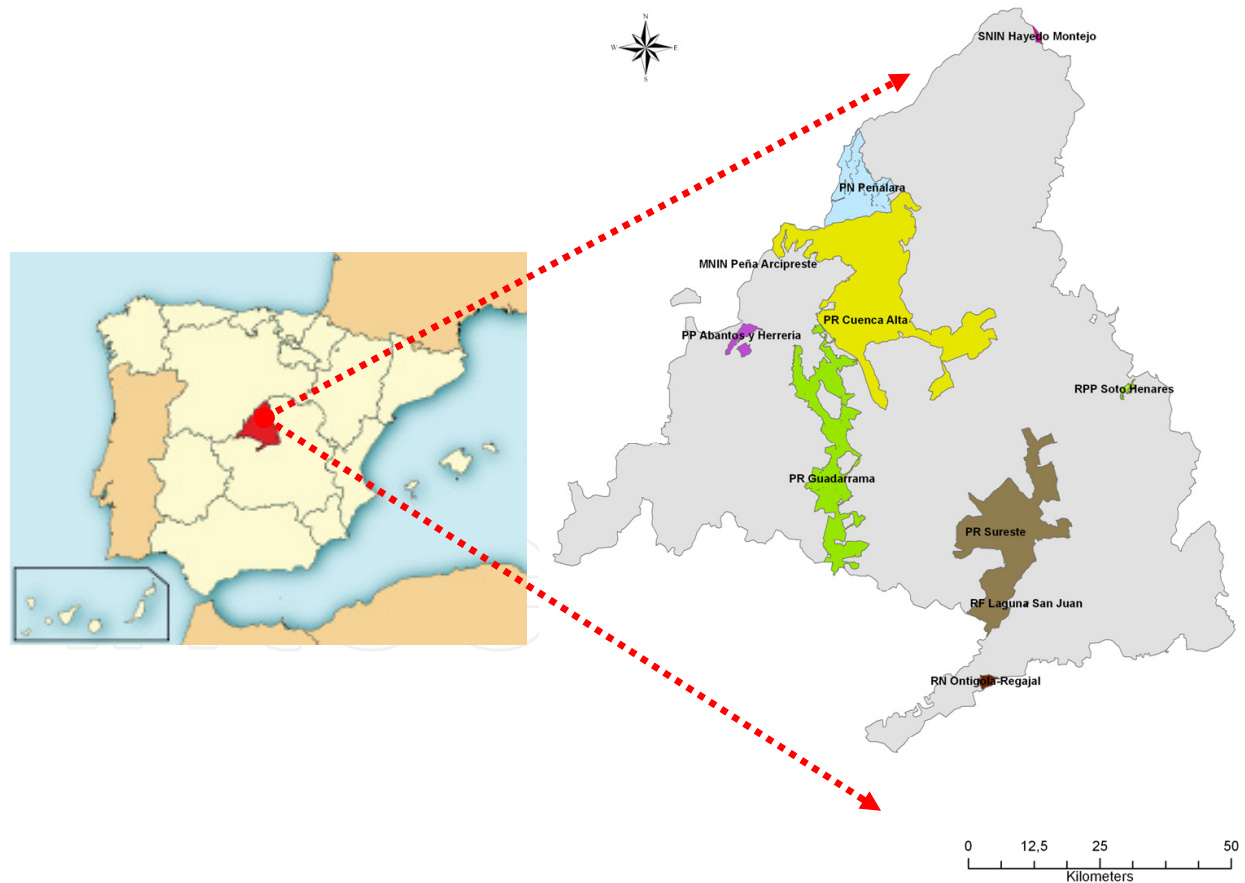
The protected areas (PAs) of the region of Madrid face numerous pressures, mainly from massive visitor use and intensive land-use transformation (Rodríguez-Rodríguez, 2008) in addition to more general threats arising from global change, such as climate change (Araújo et al., 2011). These unsustainable development dynamics raise concern that effective long-term conservation of the goods and services provided by the region's ecosystems cannot be achieved despite the fact that up to 46 % of its territory is under some kind of protection regime (Mata et al., 2009).

The ten PAs selected for this study are shown in Table 2 and Figure 6.

Protected area	Abbreviation	Area (ha)	Designation year	MAI
Peñalara Natural Park	Peñalara NP	11,637	1990	1.6
Cuenca Alta del Manzanares Regional Park	Cuenca Alta RP	52,796	1985	1.2
Sureste Regional Park	Sureste RP	31,550	1994	1.1
Curso Medium del Río Guadarrama y su entorno Regional Park	Guadarrama RP	22,116	1999	1.1
Pinar de Abantos y Zona de la Herrería Picturesque Landscape	Pinar Abantos y Herrería PL	1,538	1961	0.6
Natural Site of National Interest of Hayedo de Montejo de la Sierra	NSNI Hayedo Montejo	250	1974	1.1
El Regajal-Mar de Ontígola Natural Reserve	Regajal-Ontígola NR	629	1994	0.6
Laguna de San Juan Fauna Refuge	Laguna San Juan FR	47	1991	0.7
Natural Monument of National Interest of Peña del Arcipreste de Hita	NMNI Peña Arcipreste	3	1930	0.0
Preventive Protection Regime of Soto del Henares	PPR Soto Henares	332	2000	0.3

MAI: Value of the Management Index of the SIAPA (in a 0 – 2 point standard scale)

Table 2. Main characteristics of the ten protected areas assessed

Figure 6. Location of the Autonomous Region of Madrid and the ten protected areas included in the study

The 12 management indicators against each PA was assessed are shown in Table 3

Category	Indicator
Management	Degree of characterization of the protected area
	Degree of fulfillment of management objectives
	Evolution of feature(s) for which the protected area was designated
	Existence of sufficient management staff
	Evolution of investment in the protected area
	Effectiveness of public participation bodies
	Production and distribution of an annual report on activities and outcomes
	Easiness to identify the protected area
	Public use infrastructure
	Existence of environmental education and volunteering activities
	Sanctioning procedures
	Monitoring activities

Table 3. Management indicators included in the SIAPA

Despite the importance of management for the effective conservation of PAs (Hockings et al., 2006; Pomeroy et al., 2005), the Management Index (MAI) did not reach a minimum desirable value for the PAs of the Autonomous Region of Madrid: 0.7 / 2 points. Only Peñalara NP had "Adequate" management. Whereas four PAs, including the three regional parks and the NSNI Hayedo Montejo, had a "Moderate" management valuation, the other five PAs had all "Deficient" valuations. The lowest value was for NMNI Peña Arcipreste (MAI = 0), as all its indicators scored 0 or lacked any information to be valuated. The MAI of PPR Soto Henares was also extremely low (MAI = 0.3).

Low scores were found for two PAs which had a director at the moment of the assessment: Regajal-Ontígola NR (MAI = 0.6) and Laguna San Juan FR (MAI = 0.7). This might be due to the scarce attention paid by the administration to these two PAs, and because of the excessive amount of work of the director, who had to make compatible the management of both PAs with the management of one of the biggest and most conflicting PAs: the Sureste RP (Rodríguez-Rodríguez, 2008).

Figure 7. Fauna observation installation in Sureste Regional Park (left figure) and information panels at the entrance of El Regajal-Mar de Ontígola Nature Reserve (right figure). Poor management and inadequate visitor behaviour result in the deterioration of PAs and their infrastructure

At least 2 of the 10 PAs assessed can be deemed "paper parks", as no management activities are performed there: NMNI Peña Arcipreste and PPR Soto Henares. Other 2 PAs (FR Laguna San Juan and El Regajal-Mar de Ontígola NR) enjoy only sporadic management activities, including surveillance. All these PAs have, at best, passive management responding reactively to management and conservation needs. Another PA (PP Pinar Abantos) has regular surveillance as the only habitual management activity. The other 5 PAs (4 parks and the NSNI Hayedo Montejo) do enjoy diverse active management regularly.

The indicators that scored highest for the ten PAs were the "existence of sufficient management staff", "evolution of investment in the PA", and "existence of environmental education and volunteering activities", all with a mild 1.1 score over a maximum of 2 points.

In contrast, the indicators that scored lowest were the "effectiveness of public participation bodies" (0.0 points) and the "easiness to identify the PA" (0.4 points). Additionally, two of the 12 indicators assessed under "Management" could not be assessed due to lack of rough data: "evolution of the feature(s) for which the PA was designated", and "sanctioning procedures".

A set of ultimate reasons could explain the poor quality of management of the PAs of the Autonomous Region of Madrid, as mentioned by Nolte et al. (2010) and Pomeroy et al. (2005): competence and information dispersal among different administrative units; poor coordination among these units on policies and activities related to PAs; shortage of human and material resources devoted to management; deficient scientific knowledge; and weak institutional support to biodiversity conservation policies.

In contrast to what we had expected, the MAI was not correlated with any other index used in the study, although it might have some degree of relatedness with the Planning Index (Rodríguez-Rodríguez & Martínez-Vega, in press). The non-significant, low correlation between the MAI and the State of Conservation Index and the non-significant, moderate correlation between the MAI and the Sustainability (Effectiveness)[5] Index suggest that management is not as determinant a factor for the effective conservation of PAs.

Although management might not be as fundamental a factor for the effective long-term conservation of PAs as it had been stated, it remains nevertheless one of the most important components of PA effectiveness. The importance of management increases in contexts of numerous and intensive inner and outer pressures on PAs, as it happens in the Autonomous Region of Madrid. Thus, much more effort will be needed regarding sustainable territorial management at different scales in this urban, densely-populated region to effectively safeguard its valuable natural and cultural resources for future generations (Mata et al., 2009; Rodríguez-Rodríguez, 2012b).

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[5] See Chapter 7

14. References

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