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PROPOSAL OF A MONITORING AND EVALUATION FRAMEWORK FOR RECOVERY PROGRAMS FOR SPECIES AT RISK

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Abstract

A monitoring and evaluation (M&E) framework is proposed for evaluating the effectiveness and results of recovery programs for species at risk of extinction. The proposal is based on analysis of a Mexican governmental program that implemented 14 recovery projects over a period of ten years, revision of 11 projects pertaining to a subsequent program, participatory observation and analysis of similar programs in other countries. The proposed framework is suitable for addressing the M&E needs of the current species at risk recovery projects in Mexico. Criteria and indicators are proposed that address ecological, management and socioeconomic aspects explicit within the conservation and management actions prescribed in the recovery projects. M&E activities involve the participation of several social sectors that collaborate in conservation initiatives. Indicators were standardized in order that the information obtained, analyzed and compared can be integrated into an environmental information system for the management of species at risk.

Key words: Biodiversity conservation, Monitoring & Evaluation, Recovery programs for species at risk, Adaptive management.

Introduction

In 1997, preparation and development of 14 recovery projects[1] for priority species began within the *Program for the Conservation of Wildlife and the Productive Diversification of the Rural Sector* (PCVS, by its Spanish acronym). This program of the Mexican Government was under the responsibility of the General Direction of Wildlife (DGVS, by its Spanish acronym), as part of the Ministry of Environment and Natural Resources (SEMARNAT, by its Spanish acronym) (INE-SEMARNAP[2], 1997). Recovery Projects for Priority Species (PREP, by their Spanish acronym) were developed with the aim of defining the management actions that are necessary for the recovery of a group of species in danger of extinction (SEMARNAT, 2009a) (Table 1). In the PREP, the management actions implemented by SEMARNAT

[1] According to the General Law of Wildlife of México, "recovery" is defined as: the reestablishment of natural processes and genetic, demographic or ecological parameters of a population or species, with respect to its status on initiation of the recovery activities, as well as its former local abundance, structure and dynamics, in order to return to fulfilling its ecological and evolutionary role with a consequent improvement in habitat quality.

[2] Before 1998, this agency was known as the Ministry of Environment, Natural Resources and Fisheries (SEMARNAP).

were grouped into six strategic themes: 1) Education and Dissemination; 2) Conservation and Management; 3) Research; 4) Rehabilitation and Captive Management; 5) Inspection and Surveillance; and 6) Financial Resources. Topics of the strategies differed in each PREP, depending on the particular issues affecting the concerned species or group of species.

Table 1. List of species and groups of species with Recovery Projects for Priority Species (PREP) and Programs of Action for the Conservation of Species (PACE).

PREP
1a. Proyecto de protección, conservación y recuperación del águila real *(Aquila chrysaetos canadensis).*
2a. Proyecto para la conservación y manejo del oso negro (*Ursus americanus*).
3a. Proyecto de recuperación del lobo mexicano (*Canis lupus baileyi*).
4a. Proyecto para la conservación, manejo y aprovechamiento sustentable de los Crocodylia.
5a. Proyecto para la conservación, manejo y aprovechamiento sustentable del borrego cimarrón (*Ovis canadensis*).
6a. Proyecto para la conservación, manejo y aprovechamiento sustentable del berrendo (*Antilocapra americana*).
7a. Programa nacional de protección, conservación, investigación y manejo de tortugas marinas.
8a. Proyecto para la conservación, manejo y aprovechamiento sustentable de los pinnípedos.
9a. Proyecto para la conservación, manejo y aprovechamiento sustentable de los psitácidos en México.
10a. Protección, conservación y recuperación de la Familia Zamiaceae (Cycadales).
11a. Proyecto de protección, conservación y recuperación de la familia Palmea (Arecacea).
12a. Proyecto de conservación, recuperación y manejo del manatí (*Trichechus manatus*).
13a. Proyecto de protección, conservación y recuperación del perrito llanero (*Cynomys mexicanus*).
14a. Proyecto para la conservación y manejo del jaguar en México.
PACE
1b. Programa de Acción para la Conservación de la especie: Vaquita (*Phocoena sinus*).
2b. Programa de Acción para la Conservación de la especie: Águila Real (*Aquila chrysaetos*).
3b. Programa de Acción para la Conservación de la especie: Lobo gris mexicano (*Canis lupus baileyi*).
4b. Programa de Acción para la Conservación de la especie: Jaguar (*Panthera onca*).
5b. Programa de Acción para la Conservación de la especie: Berrendo (*Antilocapra americana*).
6b. Programa de Acción para la Conservación de las especies: Cotorras serranas (*Rhynchopsitta* spp).
7b. Programa de Acción para la Conservación de la especie: Guacamaya roja (*Ara macao cyanoptera*).
8b. Programa de Acción para la Conservación de la especie: Tapir Centroamericano (*Tapirus bairdii*).
9b. Programa de Acción para la Conservación de la especie: Tortuga Laúd (*Dermochelys coriacea*).
10b. Programa de Acción para la Conservación de la especie: Tortuga Carey (*Eretmochelys imbricata*).
11b. Programa de Acción para la Conservación de la especie: Pavón (*Oreophasis derbianus*).

*The PREPs were produced in the Direction of Wildlife of SEMARNAT from 1999 until 2006. Subsequently, in 2008, CONANP began production of the PACEs. Here, we include only the PACEs that were published up to December 2011. Consultation sources of the PREP and PACE are included in the Appendix.

From 2007, the National Commission of Protected Natural Areas (CONANP, by its Spanish acronym) took on the challenge of the recovery of threatened species and began to develop the Program of Conservation of Species at Risk (PROCER[3], by its Spanish acronym) (CONANP-SEMARNAT, 2009).

[3] It should be noted that public policy directed towards the conservation of species at risk in Mexico has undergone administrative changes during the last three Presidential administrations. First, during the administration of President Ernesto Zedillo (1994-2000), the PCVS was formed, a federal policy administered by the DGVS of the SEMARNAP and, for the very first time, a policy response was specifically defined for the management and recovery of a group of threatened species and their habitat. Continuity was given to the PCVS during the administration of president Vicente Fox (2001-2006); however, the program faced budgetary limitations, for which reason a decision was taken to terminate it in the DGVS and "migrate" it to CONANP, a decentralized agency of SEMARNAT. Finally, during the administration of Felipe Calderón (2007-2012), a program for species at risk was formed with the PROCER, already under the administration of CONANP. It is within this agency that the program has received a higher operational budget for the formulation and implementation of action projects known as PACE.

This new program has a strategic focus similar to that of the PCVS, since it includes the establishment of a collection of documents, now known as Action Programs for the Conservation of Species (PACE[4], by its Spanish acronym), that describe the management and conservation strategies, and the requirement for financial investment for the recovery of a group of species at risk. CONANP defined as a goal the generation of 35 PACE before the end of the year 2012. In common with the PCVS, the general objective of PROCER is the recovery of a priority group of species at risk of extinction, as well as the promotion and development of sustainable productive alternatives in zones of high social marginalization (CONANP-SEMARNAT, 2009). The PACE became an instrument for the planning, operation and evaluation of federal public policy directed towards the conservation and recovery of threatened biodiversity.

The evaluation need of programs for species at risk

After 15 years of the PREP (which operated between 1997 and 2007), information regarding its implementation and impacts on the recovery of species at risk is dispersed and incomplete, and exists mainly in the form of minutes of meetings, some case studies and some anecdotal evidence (Allen-Amescua, 2012). At present, there is no formal and complete evaluation that would to allow verification of the efficacy and results of PREP and PACE projects. To our knowledge, the sole exception is the National Program of Marine Turtles, in place since 1964, and for which a more complete documentation of progress and achievements exists, in the form of periodical reports (*e.g.* SEMARNAP-INE, 1999). In order to determine whether the objectives and goals of the PREP have been achieved, and to learn lessons that can be incorporated into current PACE projects, it is necessary to integrate a mechanism of monitoring and evaluation (M&E) into the institutional management systems of SEMARNAT and CONANP.

According to several authors (*e.g.* Cardozo-Brum, 2003; Cortina-Segovia and Zorrilla-Ramos, 2009), the scarcity of information regarding the results of the programs is due, in part, to the lack of a culture of evaluation of governmental intervention in Mexico. This is related to the lack of institutionalized M&E schemes and accountability for the majority of programs on biodiversity issues. It is also due to the difficult and complex nature of environmental program evaluation. On one hand, these programs imply the implementation of multiple projects with objectives that address ecological, social and economic aspects related to the conservation of natural capital and sustainable development, and on the other hand, they require the participation of diverse stakeholders. Considering this complexity, M&E of programs and availability of environmental information systems are a common necessity in governmental management (SEMARNAT, 2006; Universidad Autónoma Metropolitana, 2008; Cortina-Segovia and Zorrilla-Ramos, 2009) and a fundamental strategic task to address for the 2007-2012 Sectoral Environmental Program (SEMARNAT, 2007).

Such a lack of evaluation means that the environmental agencies and organizations have little opportunity to examine whether the goals and objectives of their programs are being achieved, and whether management interventions were appropriate and effective in terms of biodiversity conservation. This limits the feedback of the working groups and documentation of successful initiatives that can contribute to program improvement and institutional learning. Environmental agencies also lack complete

[4] Throughout the administrative periods, inconsistencies can be observed in the planning language used by SEMARNAT and CONANP. These are reflected in the indiscriminate use of the terms "program" and "project" within the documentation for the management of species at risk. According to several guides, (OGC, 2008; PMI, 2008), a project is a document in which activities are planned, with the aim of achieving defined objectives and results. Thus, a project is the smallest independent unit of activity that can be planned and executed administratively. A program, however, is an organized and coherent group of projects that are similar in nature. A program implies a superior level of planning than a project. Therefore, in order to make the planning language of this article uniform, we use the term "program" to refer to general policies for species at risk (PCVS and PROCER), and "project" to refer to the planning documents that are specific to each species (PREP and PACE).

information with which to estimate their progress in terms of fulfilling international commitments and objectives such as, for example, the Convention on International Trade in Endangered Species and the Convention on Biological Diversity (CONABIO-SEMARNAT, 2009).

Monitoring and evaluation systems are now a vital component of conservation programs that can help to improve their performance through revision of progress and results and identification of strengths and weaknesses in the short, medium and long terms (Margoluis and Salafsky, 2001; Salafsky and Margoluis, 2003; Stem *et al.*, 2005). In this sense, program evaluation offers several benefits. It can be seen as a continual process of learning that help to strengthen institutions and improve programs. Such learning can begin in the planning phase of a program and continue throughout implementation until culmination. Monitoring and evaluation is also crucial for refining and adapting strategies of management and improving agency decision making (Kleiman *et al.*, 2000; Wallace, 2003). The results of these evaluations can be incorporated into the cycle of adaptive management in order to improve the management, optimize the use of resources and time and avoid duplication of effort (Salafsky *et al.*, 2002). Evaluation of environmental and development programs is now a requisite of funding sources such as the World Bank, the Global Environment Facility and the Organization for Economic Cooperation and Development (Baker, 2000; Bellamy and Hill, 2010; Global Environmental Facility, 2010; Lamhauge *et al.*, 2011), among others.

However, traditional approaches for measuring the effectiveness of programs for the recovery of species at risk face information and methodological limitations. In general, evaluations are based on a certain ecological criterion; for example, changes in the conservation status of species. In order to make this criterion valid and useful, periodic monitoring of the abundance, distribution, density and/or population estimates of species are required, as well as an assessment of temporal changes (Block *et al.*, 2001). This criterion is incorporated into the indicators of environmental performance relating to biodiversity issues of SEMARNAT, which is based on a national list of species at risk in order to identify changes in status (see SEMARNAT, 2009b). This criterion is also used in other countries, such as the United States, Canada and Australia, for the same purpose (NRWG, 2005; NMFS-USFWS, 2010; Australian Government, 2012). From an ecological point of view, the approach is pertinent because changes observed in populations can be used as a proxy indicator of the effectiveness of management measures; i.e., successful management practices should lead to a population increase in a species, seen as a cause-effect relationship. However, according to several authors (Possingham *et al.*, 2002; Quayle y Ramsay, 2005; Ortega-Argueta *et al.*, 2011), this approach is limited because:

1. The number of species at risk is large (more than 2500 in Mexico), while the percentage of species for which population or abundance estimates exist is relatively small. This would require the continuous collection of estimates and censuses for many species in the country, an undertaking that is both costly and laborious.
2. Accurate historical population data are required in order to evaluate possible changes as a result of management interventions. This data does not exist for the majority of species at risk.
3. It is difficult to maintain up to date databases and lists of the conservation status of species; these lists generally reflect changes related to taxonomic and nomenclatural corrections and access to new information, rather than status changes as a result of population fluctuations.
4. Ecological indicators are insufficiently sensitive to measure population changes and clear trends in the short term (considering the normal duration of governmental programs in Mexico).
5. Increased abundance of a species can be multi-causal. If only ecological criteria are measured, the results, whether positive or negative, are therefore difficult to associate with management interventions and to interpret in terms of cause-effect relationships.
6. Results based only on ecological criteria and indicators are not comparable between recovery projects that are implemented in parallel, such as PREP and PACE.
7. Recovery of species at risk implies aspects of management that go beyond the merely biological. The majority of species at risk of extinction are in this condition as a result of non-sustainable human practices. Recovery programs therefore propose actions directed towards changing human attitudes and activities that affect species and ecosystems (see below). The social aspects of conservation can

constitute important evidence of the effectiveness and impact of a program; however, they have frequently been ignored as evaluation criteria (see Kleiman *et al.*, 2000; Mathevet and Mauchamp, 2005; Munro and Moore, 2005; Wilder and Walpole, 2008).

It is therefore necessary to develop studies that link ecological data with the information needs of biodiversity management systems. Our study addresses this requirement in terms of M&E (see Cortina-Segovia and Zorrilla-Ramos, 2009). We present a theoretical and practical basis for improving the planning, implementation and evaluation of programs and projects directed towards biodiversity conservation. The specific objectives of this study were: 1) To analyze aspects of planning and implementation of governmental programs for the management and conservation of species at risk, and 2) to formulate a conceptual and practical methodological M&E scheme, adapted to address the requirements of ongoing programs. The proposed M&E scheme, while created to support the management of species at risk, is also of relevance to other governmental programs that influence the management and conservation of biodiversity (*e.g.* Protected Areas, Management Units for Wildlife Conservation). Our contribution also has international relevance since it addresses the requirements for information and evaluation of official programs for biodiversity of other signatory countries of the Convention on Biological Diversity.

Conceptual and methodological framework

The theoretical analysis framework is based on the methods of evaluation research of policy and environmental programs (e.g. Susskind *et al.*, 2001; Patton, 2002; Mickwitz, 2003; Crabbé and Leroy, 2008). Program evaluation generally integrates a series of procedures, by which the different developmental phases of a program can be analyzed in order to determine merit and value, and to identify areas for improvement (Scriven, 1997). This study evaluated the design, planning and implementation phases of official programs and projects for the management and recovery of species at risk. Firstly, for the phase of design and planning, we conducted an analysis of the theory and conceptual design of the program. This type of evaluation consists of examining the conceptual construction of a program, its elements and the assumptions regarding how such an intervention will lead to obtain the anticipated results (Chen, 1990; Rossi *et al.*, 2004). By evaluating the theory and conceptual design of the PREP and PACE, we tried to determine coherence in the causal relationships between program objectives, prescribed strategies and actions and the expected impacts. For this purpose, we analyzed the strategic programs of PCVS and PROCER, of SEMARNAT and CONANP, respectively (INE-SEMARNAP, 1997; CONANP-SEMARNAT, 2009). We also revised the content of the 14 PREP published by the DGVS from 1999 to 2006, and the 11 PACE finalized and published electronically by CONANP up to December 2011 (Table 1). This enabled evaluation of the programs and projects as instruments of planning and management, based also on an analysis of the coverage of key attributes compared to international guides and planning standards (e.g. NRWG, 2005; IUCN-SSC, 2008; Dietz *et al.*, 2010) (Table 2). This study was complemented with an analysis of the management actions prescribed in the PREP and PACE to estimate the degree of coverage of strategic themes, with the aim of establishing the issues of proposed criteria and indicators for evaluation. This approach to evaluation has been applied in order to determine the quality of recovery programs for species at risk in the United States, Canada, Australia and New Zealand (Hoekstra *et al.*, 2002; Holzapfel, 2005; STRATOS, 2006; Ortega-Argueta, 2008).

The phase of implementation and operation of the projects was approached as a process of participant observation (Patton, 2002; Comboni and Juárez, 2007), in which the authors documented their experiences of participation in projects of biodiversity management and conservation: The first author (AOA) collaborated for ten years in the "Technical Advisory Subcommittee for the Manatee Recovery" (responsible recovery team for one of the 14 PREP). In this research framework, the first author worked closely with the different members of the subcommittee to determine the type of information that was generated by the implementation and monitoring of the PREP and to define the type of information that could be systematically documented in order to report the progress and results of the project. This research process included participation in: a) planning and management meetings with the Federal Government, b) annual coordination meetings of the Manatee recovery subcommittee (assisting in advice, revision and

discussion of project progress), and c) a national meeting of the presidents of the different subcommittees for all species at risk (organized to exchange experiences among representatives of the 14 PREP).

Table 2. List of key planning attributes for recovery projects of species at risk following international standards.

Attributes
1) Definition of the problem, objects of conservation and geographic range.
2) Project goals and objectives (short, medium and long term).
3) Biological/ecological information of the species of concern and their habitat.
4) Diagnostic of the main threats for the species and their habitat.
5) Set of conservation strategies and actions related mainly to species management, habitat improvement and control of threats, although actions that address social aspects, such as environmental education campaigns and lobbying meetings with landowners, can also be included.
6) Definition of performance and outcomes indicators by which to monitor the project.
7) Implementation plan that includes the detailed activities, a work schedule and a budget of the necessary financial resources.
8) List of participating people and organizations responsible for implementing the project.
9) Instructions for the periodic evaluation of the project (recommended every five years).

Source: Self-produced from the revision of policies for biodiversity conservation in the national and international context (NRWG, 2005; IUCN-SSC, 2008; Australian Government, 2008; CONANP-SEMARNAT, 2010a; NMFS-USFWS, 2010).

The second author (ACH) conducted studies on the conservation and use of an endemic species at risk, *Beaucarnea recurvate*, a plant of the Asparagaceae family. ACH: a) evaluated the conservation status of this species in fragments of tropical dry forest that present elevated rates of transformation as a result of agricultural and livestock production activities, b) facilitated the social organization for the legal use of the species in community plant nurseries, and c) supported management directed towards the commercialization of individuals cultivated in management units for wildlife conservation (Contreras and Barrera, 2007; Osorio *et al.*, 2011). The combined experience of both authors enabled the identification of the institutional and organizational mechanisms and processes for the implementation of programs of species at risk, the issues and recovery actions prescribed in the management agendas of the individual projects (PREP), the procedures for monitoring and revision of the activities of the subcommittees, and the availability of and information needs relevant to the management, evaluation and improvement of the program.

This research was complemented by interviews with members of the Manatee recovery subcommittee and representatives from SEMARNAT and CONANP, as well as a review of minutes, correspondence and meetings reports of the Manatee recovery subcommittee and authorities of SEMARNAT between 1997 and 2007. As part of the documentary research, a revision was conducted of publications that emphasize the necessity for the M&E of similar conservation programs in an international context (e.g. McGowan, 2001; The Royal Society, 2003; CMP, 2007; Vaessen and Todd, 2008; Jenks *et al.*, 2010). This comprehensive analysis established the elements that sustained the conceptual and practical design of the proposed M&E scheme. This scheme addresses the information needs identified in the official programs and can be methodologically adapted to recovery projects for species at risk, such as PACE, and can also be applied to other similar conservation programs that feature initiatives with multiple projects and objectives.

The monitoring and evaluation (M&E) scheme

This section addresses the main aspects and necessary elements for creation of the M&E scheme.

Preliminary aspects of program monitoring

Recovery projects are official management documents that contain the strategies and actions necessary for the recovery of species at risk, as well as anticipating the potential costs and benefits of interventions. These projects are developed and implemented by the personnel of SEMARNAT and CONANP, with the collaboration of groups of specialists in biodiversity, wildlife managers, representatives of non-governmental organizations, landowners and volunteers, who are guided by the management actions prescribed in the projects. The proposed M&E scheme could be an integral part of the planning and implementation of the program (PROCER) and the projects (PACE). In order for the M&E scheme to operate adequately, it is necessary to assign resources and full-time personnel to the task, since the activities of monitoring, collection and analysis of information and evaluation (e.g. field monitoring activities, periodic meetings of project coordinators) require sufficient time and resources. For this reason, the M&E scheme must be considered in the planning of the basic components of the program and in the definition of the operational budgetary requirements. Interinstitutional agreements must also be established for the continual transfer of information based on the criteria and indicators explained below. The scheme is designed for application from the outset of the implementation of each project. In this way, implementation and monitoring activities should be conducted in parallel. The monitoring activities that accompany the entire process of project implementation facilitate documentation of the results and achievements, and provide the evidence on which to base annual evaluations.

Conceptual design of the M&E scheme

As with all public policy, PROCER and PACE follow a cycle. Within this cycle, public policies are first formulated, then implemented and monitored concurrently and, finally, evaluated in order to determine their effects (Clark, 2002; Rossi *et al.*, 2004). Thus, CONANP and SEMARNAT (the agencies responsible for PROCER and PACE) require a self-control mechanism for their management to document and revise program implementation. The M&E scheme we propose helps to define a group of criteria and indicators of efficacy, performance and results that are required for the evaluation of individual projects and of the program as a whole.

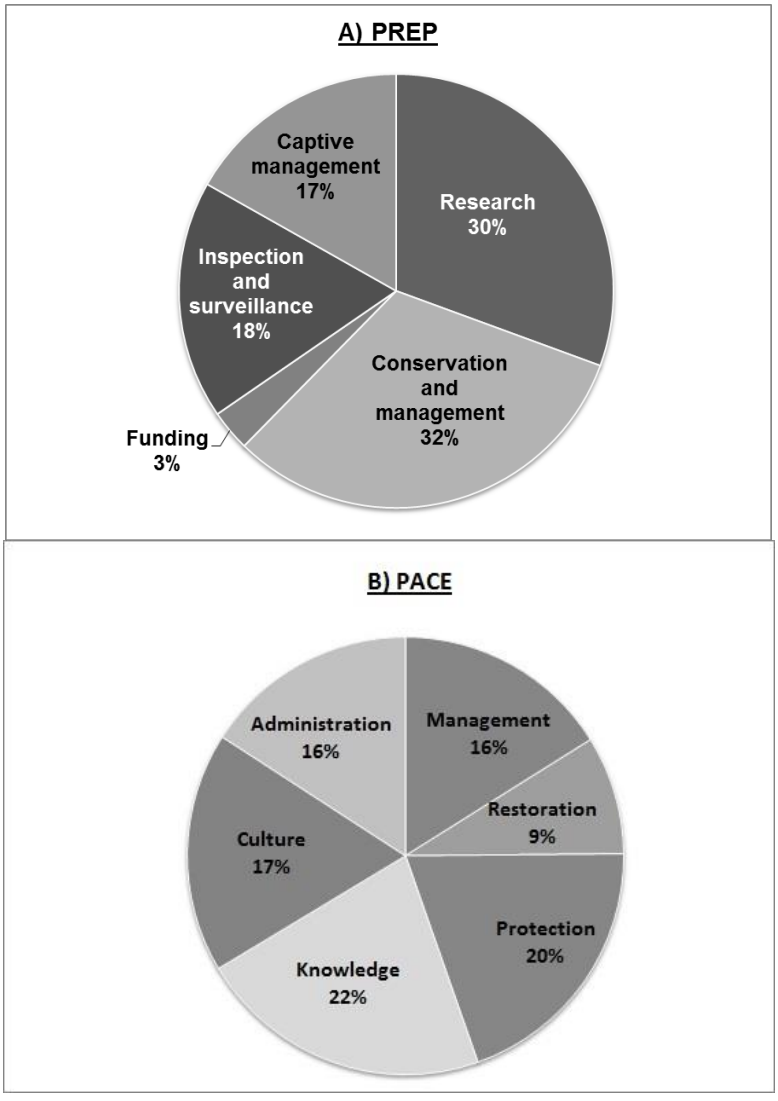
The conceptual construction of recovery programs for species at risk implies the production of a series of official management documents that help to address threatening processes and contribute towards sustainable wildlife management. The assumptions of PROCER as a public policy imply that the implementation of a group of recovery projects of species at risk at the national scale will improve the status of these species and of their habitat, and provide society with better opportunities for the sustainable management of biodiversity (CONANP-SEMARNAT, 2009). The results expected from the implementation of the projects and management interventions are a reduced number of species at risk of extinction, or at least their reclassification into categories of lower risk ("vulnerable" or "subject to special protection"). Similarly, an improvement in the habitat of these species is expected in terms of increased coverage of conserved natural areas. Finally, changes in the attitude of Mexican society towards wildlife are expected, along with an improvement in its socioeconomic well-being through the adoption of schemes and practices of sustainable management of natural resources.

With these assumptions, the projects have a prescriptive character, i.e., they contain certain elements and guidelines designed to support decision-making with respect to the conservation and management of species at risk. Each project establishes a group of strategic themes and recommends a set of actions that can be directed towards habitat restoration, research or the promotion of a culture of conservation, among other themes.

From the analysis we conducted of the strategic themes and of the management actions established in the PREP and PACE, as well as a revision of similar projects in other countries, we found that prescribed actions are directed towards the biological management of species and habitat and, to a greater extent, towards the promotion of an improved relationship between people and biodiversity. Between 70 and 80% of the prescribed actions in each project are directed towards management work with social

groups (e.g. private and community landowners, fishermen, private zoos as businesses dedicated to the conservation of wildlife) (Figure 1). This implies that projects have an important management focus on social issues. This reflects the fact that the majority of the causes driving species towards a risk of extinction are human in origin (Brooks *et al.*, 2006).

Figure 1. Strategic themes and degree of coverage of the prescribed management and conservation actions in projects for the recovery of species at risk. Source: Authors' elaboration; A) PREP (n = 14 projects), B) PACE (n = 11 projects). Each PREP and PACE has on average 76 recovery actions.



Among the main anthropogenic causes of biodiversity loss in Mexico are overexploitation of species, illegal hunting, invasive species, habitat loss and degradation caused by urban, coastal and industrial development, control of species considered harmful (*e.g.* the Mexican wolf) and non-sustainable resource management practices (e.g. extensive agriculture and livestock production) (Challenger and Dirzo, 2009; Naranjo and Dirzo, 2009).

Recovery projects therefore recommend strategies and actions directed towards promoting behavior, attitudes and human activities that are more sustainable for wildlife. Examples of this include actions to reduce the overexploitation of a species, restore deteriorated habitat and improve the sustainable

agricultural practices of a region, convince the owners of private and community lands to participate in conservation schemes, or conduct activities of environmental education in order to change the perspective of society towards a species of interest.

It is expected that the interventions will bring about changes in human attitude and behavior over the short, medium and long terms and thus improve the status of species and their habitat. It is similarly intended that actions of biological management of species, such as assisted reproduction and ecosystem restoration, will also help to improve the status of the species. The ultimate goal of these projects is the restoration of these species, in terms of population size, distribution or abundance, to such a degree that they are no longer considered in danger of extinction.

Table 3. Themes and types of management and conservation actions included in the recovery projects of species at risk that can be associated with performance indicators and results for the M&E.

Themes	Examples of actions
a) Research and monitoring	Scientific studies on taxonomy; population estimates and distribution; population viability analysis; assessment/mapping of habitat; threat assessment.
b) Species management	Cultivation, captive breeding, enrichment, propagation, reintroductions, translocations.
c) Habitat management and protection	Restoration/improvement of habitat quality; establishment of reserves; units for wildlife management (UMA), protection of habitat through land co-management or acquisition; use of economic incentives.
d) Threats management	Measures of prevention/mitigation; hunting/exploitation regulation; management of introduced pest species (predators, competitors, parasites); reduction of incidental mortality; regulation of pollution; control of fires.
e) Community participation	Negotiation of conservation agreements between governmental agencies and communities; collaborative projects; lobbying and participation of landowners/private groups in conservation actions; volunteering schemes.
f) Education, awareness and training	Implementation of education projects; environmental campaigns; raising public awareness; dissemination of projects information; local capacity-building (training of volunteers).
g) Organization and management of governmental agencies	Activities relating to agency performance; activities of working groups/subcommittees; lobbying and coordination between agencies; coordination of project implementation; revision and evaluation.
h) Policy and legislation	Implementation of international treaties; regulation of trafficking and trade of species; establishment of new reserves, regional management plans (*e.g.* ecological territorial legislation); sectoral policies (forestry, fishery, agriculture); compliance with the legislation, inspection and surveillance.

Sources: Typology based on the revision of Mexican (25 projects; Allen-Amescua, 2012) and Australian (236 projects; Ortega-Argueta, 2008) governmental projects for the recovery of species at risk.

However, the goals and objectives of the projects are not only directed towards addressing biological aspects of species conservation, but also focus on improving the well-being of the stakeholders involved through fostering sustainable productive activities, capacity-building, community organization and the sum of institutional synergies (CONANP-SEMARNAT, 2009). In this context, the criteria and indicators we propose for the M&E scheme are based on the ecological and socioeconomic aspects implicit in the management and conservation actions the projects, as presented in Tables 3 and 4, generated from themes identified in the revision of the PREP and PACE. In addition to the necessity of monitoring the condition of species and their habitat, revision of projects implementation and the impact they have on human behavior is also required, especially in attempts to reverse the activities and processes that have placed the species in danger of extinction. In this regard, the government of Canada (NRWG, 2005) proposes a series of aspects for the M&E of recovery projects for species at risk: 1) the achievement of established goals and objectives; 2) changes in population size of the species, trends and productivity

(with an explanation of the reasons for these changes); 3) restoration and protection of the habitat; 4) success in the mitigation and control of threats; 5) the degree of participation of pertinent stakeholders; 6) the success of environmental education activities conducted as part of the project; and 7) the degree of public support for the implementation of actions of the project. These interventions require careful monitoring conducted in parallel with the ecological monitoring of the species and their habitat.

Table 4. Examples of ecological, socioeconomic and management criteria, indicators and metrics used for the M&E of recovery projects of species at risk.

Criteria/Indicators	Examples of metrics (qualitative and quantitative)
Ecological	
Status of the species/populations/communities.	Estimations of abundance/density.
Habitat quality.	Vegetation cover.
Ecological processes.	Recruitment of new individuals.
Health of the species/ecosystems.	Presence/absence of indicator species.
Threats to the species and its habitat.	Abundance of invasive species.
Socioeconomics	
Environmental awareness in the community.	Survey of environmental perception.
Participation of the community in management and conservation activities.	Attendance of consultation/planning forums.
Level of well-being in the community.	Access to public services.
Production of goods derived from conservation and sustainable management.	*Per capita* income from goods produced in sustainable wildlife projects.
Management and governance	
Democratic participation of the community in the planning of conservation initiatives.	Access and participation in decision-making.
Stakeholders' representation in working groups.	Minutes of meetings.
Compliance with environmental standards and regulations.	Degree of compliance of a community with respect to the environmental regulations.
Degree of implementation of project activities.	Periodic revision of the operational plan of the project.

Source: Authors' elaboration, based in Nelson, 2004; Pomeroy *et al.*, 2004; Fenton, 2006; Plummer and Armitage, 2007; Schreckenberg *et al.*, 2010. These indicators are established from the revision of the management and conservation actions shown in Table 3.

Only through comprehensive recognition of all aspects that form a recovery program for species at risk (e.g. ecological, socioeconomic, technical, political and institutional), and the establishment of appropriate ecological and socioeconomic criteria and indicators, can a solid and complete base be created for the evaluation of its effectiveness and results. The academic literature on environmental management, sustainability and human development provides various examples of ecological and socioeconomic indicators (*e.g.* Nelson, 2004; Pomeroy *et al.*, 2004; Fenton, 2006; Plummer and Armitage, 2007; Schreckenberg *et al.*, 2010) that can be incorporated into a M&E scheme such as that of the recovery projects (see examples in Table 4). This diversification of criteria for M&E also resolves the limitations of information described earlier in the case of using only ecological criteria.

For the establishment of indicators, the consistency between the project objectives, strategies, prescribed actions, performance indicators and results, and the monitoring activities, must be revised carefully. Table 5 presents some examples of indicators and their logical M&E framework.

Due to logistical, personnel and funding restrictions, not all of the recovery actions can be monitored. It is therefore necessary to identify those actions that are most relevant for monitoring, are feasible and easy to measure and that provide the best evidence of projects' implementation and results.

Table 5. Examples of a logical framework for the establishment of performance indicators and results for the monitoring and evaluation of recovery programs for species at risk.

Objectives	Strategies/Actions	Performance indicators	Monitoring activities
1) Increase of the population and the spatial distribution of plant X to ensure its survival in the wild until 2020.	a) Establish a number X of individuals in an enclosure protected from herbivores.	● Increase of 10% in the population and a rise in the number of its patches of occurrence to 300 over the period of the project.	● Measure the population size and the area of occurrence in specific sites, once every six months over the period of the project.
	b) Implement an eradication project introduced competitor species.	● Decrease of 50% in the abundance of introduced competitor species	● Measure the abundance of introduced species and the number of areas affected, once every two months over the period of the project.
2) Increase public awareness on the protection and conservation of the species until 2020.	Conduct an awareness-raising campaign about conservation of the species in the region.	● The number of people willing to conserve the species within the community increases by 50% by the end of the project.	● Conduct a survey of the people's attitude at the outset and at the end of the project in selected sites and communities.
		● Establishment of at least two conservation groups with 30 members each in the local community.	● Monitor the establishment of the community groups, and their attendance and participation in work meetings.
3) Improve the management capacity of the governmental agency in the region.	Hold a series of planning and training meetings with the relevant stakeholders in the local community.	● Satisfactory attendance of the planning and training meetings (number of attendees) with representation of at least 70% of the stakeholder groups invited.	● Measure the attendance, diversity and cohesion of the groups of stakeholders invited to the meetings.

Source: Framework based on the revision of Mexican (25 projects; Allen-Amescua, 2012) and Australian (236 projects; Ortega-Argueta, 2008) projects for the recovery of species at risk.

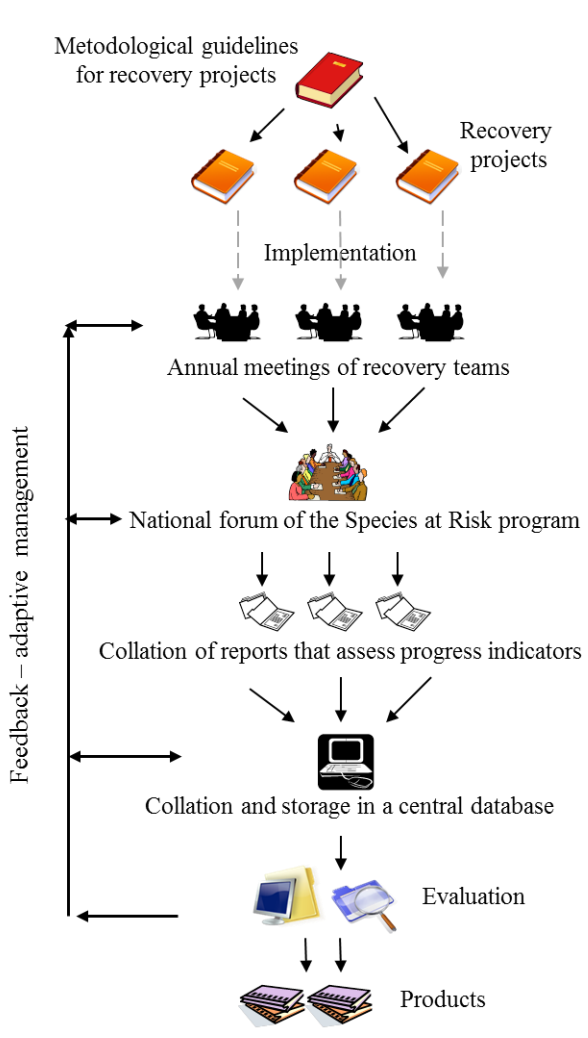
Information management system

It is important to clarify that the typology of the strategies, actions and their performance indicators and the measurement of results should be, as much as possible, homogenous among all recovery projects. In this way, standard protocols can be developed for the collection of information. This, in turn, will enable the storage of systemized information with which to compare progress and results among projects executed in parallel, such as the PACE, and the exchange of experiences among working groups (or subcommittees), CONANP and other governmental agencies. To help the coordinators of each project establish standardized indicators, it is necessary to produce a M&E methodological guide that includes a catalog of criteria and indicators adapted to the particular circumstances of each project. This guide will be a format for producing the content of projects, and will also help with the use of a common nomenclature and to comply with planning standards (see Table 2). This is essential for the measurement and comparison of progress and results among several recovery projects.

The coordinators of each project or working group will collect the monitoring information of the indicators and results in a report following a standard format and remit this to an information system (IS) pertaining to the program (Figure 2). The IS will provide information to support management decision-making, including information that forms the basis for routinely evaluation and guide the improvement of

programs (Allen *et al*., 2001; Bosch *et al.*, 2003). The IS will also include a collection of qualitative and quantitative results that facilitate monitoring of indicators and should be readily available to other governmental agencies, recovery working groups, users and the other organizations involved. Access to the information and feedback among the participant working groups can be facilitated through the use of an internet web site (as a reference, see the site of ConPro, from The Nature Conservancy, http://conpro.tnc.org). The IS will enable the identification and understanding of similar issues, improve communication and transfer of information between governmental agencies and the working groups, and continual learning in terms of project operation. This IS can be incorporated into the Information, Monitoring and Evaluation System for Conservation (SIMEC, by its Spanish acronym; https://simec.conanp.gob.mx/) that is currently administered by CONANP (CONANP-SEMARNAT, 2010b).

Figure 2. Monitoring and evaluation scheme of programs for the recovery of species at risk. This scheme integrates elements of adaptive and participative management related to activities of revision and self-analysis, and features the participation of various stakeholders in the implementation and monitoring of the management and conservation activities of various parallel projects. Source: Authors' elaboration.



The guidelines contain instructions to conduct M&E of recovery projects. It includes a catalog of stardandized performance and results indicators related to biological, socioeconomic and management aspects.

Recovery projects are prepared and aproved on the basis of the guidelines.

Recovery strategies, progress and management actions are revised, together with successes and challenges. This is helpful for making adjustments to the program. Annual meetings can improve organizational capacities and collaboration with other sectors.

Progress and advances of each recovery project are revised against monitoring indicators. Results are compared in a discussion on the similar challenges.

Database storages qualitative and quantitative information in a standardized format, and using common nomenclature, in order to facilitate analysis.

Recovery projects information is collated and analyzed. Program achievements (short- and medium-term), effectiveness and efficacy are identified, which may lead to program improvement.

A variety of information products is produced, including reports to donor agencies, government accountability, and dissemination of relevant program results.

Periodic revision of progress and results of the PACE

An annual progress report should be produced for each project, using the standardized form to provide information pertaining to the monitoring of the indicators and notable results. These annual reports could be analyzed and compared in a national forum with representatives of each project and the working groups, together with representatives of CONANP, SEMARNAT and the other agencies involved (Figure 2). In this way, strategies and actions can be revised in order to identify progress and successful interventions, determine the challenges and obstacles to be overcome, redirect strategic approaches, and avoid duplication of efforts and repetition of errors documented in other projects. The forum will also serve to achieve a greater appreciation of the common problems at the national scale and the overall impacts of the strategies and actions implemented in order to achieve the goals and objectives of the PACE and of the PROCER, as a whole. This comprehensive analysis will help to improve programs through adaptive management, which implies a continual cyclic process of self-analysis and evaluation that leads to a refinement of the interventions (Salafsky and Margoluis, 2003; Smith *et al.*, 2007; Cundill and Fabricius, 2009). According to Priddel and Carlile (2009), adaptive management is necessary in order to address the complexity and uncertainty associated with the recovery of species at risk, and brings a focus onto the evaluation of the response of species and habitats under management.

Participation of stakeholders

The M&E scheme initially implies the establishment of collaboration networks and participation commitments between governmental agencies and different stakeholders (CONANP-SEMARNAT, 2009). These collaborative commitments may include the participation of different working groups, such as technical subcommittees of experts, agencies of the three levels of government, zoos and aquariums, non-governmental organizations, organizations of producers, owners of land under conservation, participative environmental surveillance committees, inhabitants of rural communities, businesses and volunteers (CONANP-SEMARNAT, 2009). The operational framework is outlined within a scheme of participatory management (Allen *et al.*, 2001; Schusler *et al.*, 2003; Cundill and Fabricius, 2009), which is determined by the criteria of co-responsibility and participation of social collectives in the implementation and evaluation of the projects and in the validation of their results (CONANP-SEMARNAT, 2009).

At present, local stakeholders are more involved in environmental management, proposing traditional schemes of use, management and conservation of biodiversity (Boege, 2008; Ortega-Argueta and Contreras-Hernández, 2013). Non-governmental organizations and civil society groups are driving initiatives of community management with a participative approach that has proved to be more effective than the traditional centralist approach (*e.g.* Paré and Sánchez, 1996; Guerra *et al.*, 2010). This participative approach can be seen as an opportunity since it helps to mitigate the budgetary and personnel limitations of the majority of governmental programs (see Cortina-Segovia and Zorrilla-Ramos, 2009). Thus, in participatory management approach, an important number of prescribed recovery actions and the monitoring and evaluation activities can be conducted by local stakeholders (McDuff, 2001; Evans and Guariguata, 2008), coordinated by CONANP, in collaboration with the functionaries of the three levels of government.

The participatory management approach is explicit in the majority of the new PACE projects, which foster social participation and organization through the biological monitoring of the group of species at risk, both inside and outside of protected areas (SEMARNAT, 2010; SEMARNAT-CONANP, 2011). For this reason monitoring protocols are being developed for different taxonomic groups of species. With the help of experts, groups of volunteers and local inhabitants have been trained to carry out monitoring and to collect information with the required technical rigor (SEMARNAT-CONANP, 2011). Community surveillance committees have also been formed, which helps to prevent illicit activities that affect the wildlife, and support communication between the local inhabitants and the three levels of government (Chávez and Ceballos, 2006). Various civil society groups are integrated into the community mechanisms of monitoring and evaluation that assess the management indicators proposed in the projects and promote

sustainable activities for the species conservation (Chávez and Ceballos, 2006; SEMARNAT-CONANP, 2011).

Recovery projects must clearly define the roles and the degree of participation of the collaborators in monitoring activities. Once responsibilities have been defined, training workshops can be used to verify the monitoring protocols, methods and indicators, in order to achieve standardization and their validity for the groups of collaborators. Through this process of co-participation in the monitoring and revision of project progress, stakeholders will be able to learn about the applied conservation actions and their results, improve their capacities for action and verify for themselves the effectiveness of their efforts in terms of project development (McDuff, 2001).

Participatory evaluation could also strengthen the collaboration of society through recognition of its civic participation. The technical advisory committees, working groups and the participatory surveillance committees are a fundamental component in recovery projects, for which reason they require the recognition of the environmental authorities through the documentation and publication of successful initiatives (*e.g.* Allen Amescua, 2012). Permanent communication between the collaborative groups and the governmental agencies is crucial in order to maintain the exchange of information and make necessary adjustments to the projects. In this way, both the government and the civil groups can share the management learning process.

Reporting, evaluation and dissemination of results

Analysis of the processed M&E information of each project can be documented in annual reports and in a final report at the end of the project. In certain countries, such as the United States, Canada and Australia, it is recommended to conduct evaluations of these programs in five-year periods. A general analysis of the performance indicators and the results of all of the projects will provide the evidence required to evaluate the effectiveness of the PROCER. Evaluations will not simply focus on the generation of information regarding the number of projects prepared, the number of projects in operation or the quantity of money invested. They must go beyond these measures; they must investigate the institutional, organizational and planning structures, arrangements and processes, in an effort to determine whether projects have achieved their goals and objectives, and why some projects are successful and others not. Other questions that may be answered by the evaluation of recovery projects are shown in Table 6. The anticipated formulation of this type of questions during the project planning phase will help to determine what type of information is available and what information is lacking to support the evaluation. This diagnostic will also help to define the type of data that will be incorporated in to the information systems as a result of project monitoring.

Table 6. Questions that can be addressed in an evaluation of recovery projects for species at risk.

1.	Have the species at risk and their habitats recovered as a result of the strategies of recovery projects?
2.	Have the goals and objectives of the recovery project been achieved?
3.	Were the project strategies implemented effectively and did they have the expected impact?
4.	Were the strategies and actions formulated in the projects appropriate?
5.	Were the invested resources and efforts assigned to the correct priorities of projects?
6.	Has the work of the governmental agencies and the subcommittees been effective in terms of coordinating the national and international efforts of projects?
7.	Is it possible to determine whether the proposed interventions in the recovery projects improved the status of the threatened species?
8.	What are the main lessons and results of the work of subcommittees and the recovery projects?
9.	What is the value and impact of all of the strategies and projects towards the recovery of threatened Mexican species?
10.	What aspects can be improved in the planning of strategies and projects?

Source: Self-produced from the revision of policies for biodiversity conservation in the national and international context (NRWG, 2005; IUCN-SSC, 2008; Australian Government, 2008; CONANP-SEMARNAT, 2010a; NMFS-USFWS, 2010).

The combined evidence of the projects will also help to address the requirement for information in different formats and for various users (Figure 2). This is due to the fact that governmental representatives may require periodic reports for various agencies, such as international conventions on biodiversity conservation, funding sources involved in the projects, governmental agencies responsible for revising accountability and the conservation and civil organizations that collaborate with the projects. The proposed M&E scheme can thus address and adapt itself to these different needs for information and facilitate the dissemination of that information in different forums and publications.

Conclusions

Recovery of species at risk of extinction requires the consideration of various dimensions of the problem, including the scientific, social, institutional, economic and political aspects, since the majority of these species are at risk because of non-sustainable human activities and practices. These aspects, often ignored, have a great impact on the success or failure of species at risk programs (Boersma *et al.*, 2001; Hoekstra *et al.*, 2002). With the implementation of the M&E scheme we propose, the governmental agencies and the conservation and civil organizations will have systemized information with which to examine whether objectives have been met and whether management interventions were appropriate and effective.

The constant feedback of working groups, added to the documentation of the successful initiatives, can improve and elevate the profile of biodiversity programs. The M&E scheme can serve as a reference for the design and adoption of a similar scheme in the program of recovery of species at risk (PROCER). This contribution addresses a priority need in Mexico and in other countries, given that conservation programs must improve in terms of effectiveness, achievement of goals and objectives and efficiency in the assignation and use of resources, while working to achieve a closer relationship with society.

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Appendix. Information sources of Mexican recovery projects (PREP and PACE)

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