

Environmental education indicators system for protected areas management



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ABSTRACT

A new perspective for the management effectiveness of protected areas needs the inclusion of social data for decision-making. In this process, environmental education (EE) plays a key role in catalyzing biological and social issues in the management process, but there are scarce data about this relationship. The objective of this paper is to develop, from an institutional bottom-up perspective, a proposal for a set of EE indicators that is easy to use by practitioners to measure the response of the EE program in relation to the conservation objectives of protected areas management plans. Using a combination of quantitative and qualitative techniques, a case study at the National Parks System of Colombia is presented, which is divided in five stages: 1. An EE evaluation survey on a national scale. 2. An interview phase with EE practitioners and NGOs. 3. EE objectives categorization. 4. Systematization process and 5. Focus group to evaluate the proposed set of indicators. A set of 5 EE indicators was developed to fulfill the identified needs: appropriation of information, articulation, participation quality, program implementation and continuity of EE process. We expect that this new approach for EE evaluation will hopefully be adopted in the update of management plans, as an innovative tool that contributes to the effectiveness assessment of protected areas, integrating a more social and participative focus.

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1. Introduction

A crucial step forward in the conservation field has been the moving beyond the establishment of protected areas to the assessment of management effectiveness (Hockings et al., 2004). Environmental indicators are essential tools in this progress, but the lack of social data is still a common problem that these protected areas face (Moon and Blackman, 2014; Popescu et al., 2014; Stephanson and Mascia, 2014). New integrated solutions must be developed, and environmental education (EE) could be a key piece to bridge the gap between people's needs and biological aims. This conservation practice can be useful for a better decision-making, communication and policy development, (Bearzi, 2007; Mascia et al., 2003; Meijaard et al., 2014), so a measure of its true scope is necessary.

Any measure of conservation is inadequate without education and a direct involvement of the different social actors (Mascia et al.,

2003; Sherrow, 2010). Fortunately, a shift in conservation science is taking place and a need to include social research is increasingly growing (Fisher et al., 2005, p. 2, 15; Linton and Warner, 2003; Mascia et al., 2003; Moon and Blackman, 2014; Stephanson and Mascia, 2014). Therefore, conservation is related to people as much as it is to species or ecosystems.

From the First Intergovernmental Conference on Environmental Education Tbilisi in 1977, EE can be defined as a holistic approach, rooted in a broad interdisciplinary base, which acknowledges the fact that natural environment and man-made environment are profoundly interdependent. EE uses the findings of science and technology to play a leading role in creating awareness and a better understanding of rapidly evolving environmental problems. It should foster positive patterns toward the environment and the nations' use of their resources, to make intelligent, informed and well structured decisions (UNESCO, 1979, p. 24).

Inclusion of EE within management plans is still in its infancy (Muñoz-Santos and Benayas, 2012), and with the current environmental crisis, education must be considered as a principle for biological conservation and management (Abdulla et al., 2008, p. 132; Brewer, 2006). Assessments based on knowledge gain are already on the shelf (Kuhar et al., 2010; Ruiz-Mallen et al., 2009),

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however it is also important to move a step forward, and measure why and how EE works (Pomeroy et al., 2005; Stern et al., 2013).

The Organization for Economic Co-operation and Development (OECD) has long been a pioneer in the field of environmental indicators. It developed and published the first international set of environmental indicators in 1993, describing 12 main rules of what an ideal indicator should be in terms of policy relevance and utility for users, analytical soundness and measurability (OECD, 2006, p. 143). These first guidelines have been used as a reference point for benchmark organizations like the World Bank, International Union for the Conservation of Nature, and International Cooperation Agencies, among others, to develop environmental and sustainability indicators, with small variations according to their needs and objectives (Global Environmental Facility, 2010; IOC-UNESCO, 2006; Pomeroy et al., 2004; Segnestam, 2002; Tilbury et al., 2007).

Governance and socio-economic indicators found in evaluation manuals for protected areas often include EE issues, but they provide limited information about the appropriateness and effects of EE on the conservation aims of the protected area. Some examples of such indicators are: establishment of education and training programs, increased awareness of environmental issues or number and trained decision makers (Borrini-Feyerabend et al., 2013; IOC-UNESCO, 2006, p. 129; Marino et al., 2015; Pomeroy et al., 2005).

Kuhar et al. (2010), went further. They measured knowledge gain through EE programs in a quantitative way. The study compared the performance of an EE conservation program in Uganda, using pre-post tests after 30 days, 1 year and 2 years from the initial program. They demonstrated that knowledge gain was not transient, but did not guarantee that proper behaviors would be performed in a middle-long term time frame.

To improve the evaluation process, the EE indicators should be quality based, embracing quantitative and qualitative measures, to provide additional details to understand not only if EE works, but also why and how it works (Stern et al., 2013). Attention must be focused to link EE activities, processes and evaluation to the park's conservation aims (Claudet and Guidetti, 2010; Muñoz-Santos and Benayas, 2012), starting a strategy of continuous assessment (Blumstein and Saylan, 2007). The new EE approach should be inclusive with stakeholders who have a direct impact on the achievement of management objectives and are directly influenced by management decisions (Himes, 2007; Zorrilla-Pujana and Rossi, 2014).

Through a revision of a wide environmental and sustainability indicators sets, the present study found that criteria used by the Global Environmental Facility (GEF) were the most suitable for the research. GEF works with 5 criteria denoted by the acronym SMART, meaning that indicators should be specific, measurable, achievable, relevant, and time-bounded (GEF, 2010, pp. 28–29).

With these indicators' guidelines established, we conducted an action-research guided by the critical theory paradigm (Crotty, 1998, pp. 139–159), which dictates how data collection and interpretation will be done. This branch of social research intends to challenge, induce and document a change in the reality studied (García and Sampedro, 2006; Sauvè, 2000). It looks to improve some practical aspects of reality as a means for developing our understanding of it, through a participative and empowering focus and praxis (Moon and Blackman, 2014; Winter, 2002).

Having selected this roadmap and following the pressure-state-response indicator framework, the objective of this action-research was to develop a theoretical EE indicator set proposal from an institutional bottom-up perspective that is easy to use by practitioners and induces a change in the EE evaluation system. These indicators will assist in measuring the influence of the EE programs on the conservation objectives of the Park's management plan, using the NPS of Colombia as a case study.

2. Methods

The action-research was conducted using a combination of qualitative and quantitative methodologies (Fig. 1). The use of both compatible and complementary methodologies provides a better understanding of the national and local context during the study, considering an approach that incorporates social variables in the evaluation of protected areas management (Benayas et al., 2003; Dillon and Wals, 2006; Gerson and Horowitz, 2002; Russell, 2006).

To avoid failures or misunderstandings in the written questionnaire, as well as in the semi-structured interviews, both questionnaires were validated at the central office of the NPS. During tool validation, members pointed out questions that were not consistent, difficult to understand or confusing and/or time consuming in order to adjust the tools before its application.

First, a quantitative methodology was used in the manner of a questionnaire; secondly, a qualitative methodology in the form of interviews, categorization process and focus groups. ATLAS.ti 6.2.27 supported qualitative data analysis, allowing us to use the same categories used in the interviews and surveys.

2.1. Survey – questionnaire

The questionnaire was developed through three main steps: content selection, structure-design and format. In first place, we developed questionnaires following the structure and functions of the EE program within the NPS (UAESPNN, 2005, 2001), which we divided into 5 categories: objectives of the program, institutional and coordination support, audiences and activities, participation and communication, and assessment (this last section is the one analyzed for this paper). In second place, questionnaire design and structure consisted of closed questions, where alternatives answers were given to respondents. We also included an open question in each section for comments and reflections ((Fernández, 2007; Himes, 2007). Questionnaire format was chosen through the formats developed by the webpage where surveys were designed (www.surveymonkey.com).

The questionnaire was sent to all EE teams in the NPS between 2011 and 2012. To obtain the most objective data from the work experience, we emphasized that the survey was not an evaluation of their work, and responses were for research use only.

The questionnaires were delivered to a total of 45 National Parks that have an EE program running (80% of National Parks at the time of the survey) and also to the NPS central office, where a total of 46 surveys were registered. A sample of 20 questionnaires from NPS (43%) at local, regional and national level was used for the research regarding EE evaluation (see [supplementary material](#) for geographical distribution of participation). The 26 remaining surveys (56%) were not included in the analysis because answers were not complete or were inconsistent.

The survey was used for the purpose of providing an insight into EE staff perceptions and the current situation relating to EE evaluation, through closed questions with an open comment section (see [supplementary material](#)).

Given the fact that in most cases there is only one person in charge of this area at local and regional level, we did not have to choose specific criteria to determinate a sample of surveyed educators. In cases where there was more than one, all the EE staff filled questionnaires when it was possible.

2.2. Interviews

Semi-structured interviews with 11 staff members from the central and local offices and environmental NGOs were performed during 2011–2012 to shed light on the process of investigation (Gerson and Horowitz, 2002). The time frame of the interviews

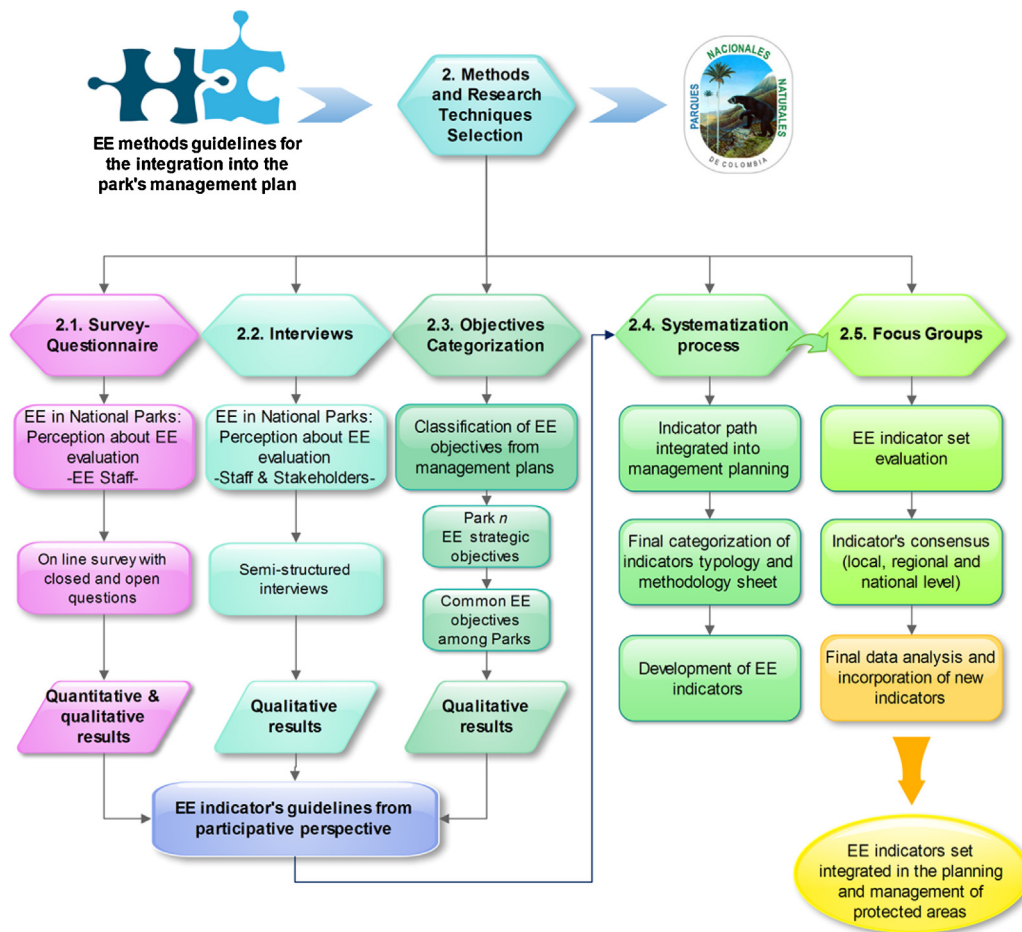


Fig. 1. Quantitative and qualitative methods used in the research.

were of 1–2 h following an open questionnaire guideline (see [supplementary material](#)). The criteria used to select interviewed staff were their direct relation with the EE program within the management group and their availability for the interview. The NGOs selected were the ones that responded to the call for participation in the research and with special focus on nature conservation.

2.3. Objectives categorization

An institutional EE indicator workshop was carried out, in which 14 assistants from EE staff were present from local, regional and national level (10, 3 and 1, respectively). Although it was not possible to organize a workshop with all EE educators, a homogeneous geographical representation was achieved.

A filtering and categorization process of EE objectives of the new management plans was developed. This classification was the starting point to define the indicators' typology so they could be useful to most of the EE teams with all management levels (Reed et al., 2008), and more suitable for their inclusion into the evaluation format.

Assistants were asked to define each objective of their own EE local management plans using a keyword. Later, all keywords were put together for grouping, and the categorization process was carried out, for the consolidation of a unique list of common objectives.

2.4. Systematization process

Once the categories were established, a multidisciplinary team was formed including EE researchers, the head of the EE team and

the head of effectiveness management at the central level, to search for adequate indicators to fit into the defined categories. A deep bibliographic revision on the topic was carried out in order to search for existing indicators within the EE field or similar, to construct the proposal.

To systematize the process in the design of an indicator system structure, we followed some of the rules described by Fontalvo-Herazo et al. (2007). These rules consisted of four levels: principles, criteria, indicators and verifiers. Principles are the NPS objectives. Criteria are the objectives of the protected area in relation to EE. Indicators are those elements identified to give a measure of the state of the EE program in a specific protected area. Finally, verifiers are the data needed for assessing an indicator.

Having identified an initial proposal for the set of indicators, a series of interdisciplinary meetings with workers from the areas of management effectiveness, monitoring and control and surveillance were held. Feedback was received to improve the proposal so indicators could be as practical and understandable as possible for the whole NPS. This networking was critical for the success in the dissemination of EE indicators and a step forward for their inclusion into the new management plans being elaborated during the years 2014–2015.

2.5. Focus group

Finally, to evaluate the proposed set of indicators, a focus group (Krueger, 1988) was carried out at the end of 2012 to detect strengths, weaknesses, and generate new ideas and recommendations. The focus group included 11 members of the NPS EE team

from national, regional and local offices. This technique gave us information about perceptions, feelings and attitudes of the indicator system proposal and its application viability (Morgan and Scannell, 1998), allowing us to see the reality from an institutional bottom-up point of view and not from the usual top down perspective.

During the focus group three EE response indicators were presented and four questions were used to guide the group's responses.

- a. Do you think the indicator's name is appropriated for what it is measuring?
- b. Would you be able to use this indicator?
- c. Is the indicator useful to your EE evaluation task?
- d. Do you think there is a way to improve it?

3. Results

In first place, quantitative results from the national survey are presented, in which responses from questionnaires are also supplemented by comments given by respondents, in cases that they are considered necessary.

In second place, qualitative results are presented as a result from interviews, divided in 4 thematic areas: (i) Indicators, (ii) Networking and Participation, (iii) Objectives, structure, systematization and planning, and (iv) Economic criteria, continuity and social perception. In a parallel way, results from the categorization work made by EE staff are presented, continued by the systematization process, indicators selection and the focus group for a bottom-up evaluation. As a final compendium of results, the EE indicator set proposal is presented.

3.1. Questionnaire-survey

According to the survey, a 90% of NPS educators' answers perceive that the EE program improves the state of conservation of the Parks, and 75% of the sample perceive that EE objectives are achieved. However, half of those surveyed responded that they do not have an existing EE program, but surprisingly they know EE objectives and the EE program is carried out systematically and consistent with the Park's objectives.

In addition, poor evaluation system of the EE program is recognized, together with the low positioning within the management area, as two correlated factors.

... "The EE program should be positioned in the park. This is the most important criteria in order to achieve the conservation objectives".

... "Actions are performed but their effectiveness or relevance are not evaluated".

Analyzing the evaluation process in more detail, data shows a gap in the systematization proceedings, such as written annual reports, information recording and reflections on the educational activity.

... "There is an excel table for the environmental education program in each area to fulfill, but measurement of indicators, feedback, and reflections are not frequent. The ideal way to do it, is to have all the team together but opportunities and means are scarce".

The gap increases when participants are asked about monitoring and direct evaluation, where just 30% confirmed that a monitoring process is carried out and only 20% use indicators.

... "Indicators are being constructed. These indicators for environmental education should be formulated to measure the

change in attitude of our subjects, and should be measurable, real and contextualized".

... "Currently, the process of continuous evaluation is being defined and should be measurable".

3.2. Interviews

For the content analysis of interviews, an evaluation category was established as the backbone code to cluster all questions and answers that were related with this thematic line, integrated by a total of 43 quotations linked to 11 codes. In this analysis, with the exception of the emerged continuity code, the remaining 10 codes were defined by the integration of the conceptual framework of the research and the keywords from the interviews structure that shaped the study (Miles and Huberman, 1994, p. 58).

In this study, what we wanted to measure was not only the frequency of appearance but also the relationships among codes, which are explained in a hierarchical scheme (Fig. 2).

A better evaluation system beyond program outputs is a common answer among respondents, in which indicator development, better internal and external networking with more inclusive participation, continuity in EE processes and EE objectives definition, constitute more than 70% of the total content.

3.2.1. Indicators

Answers linked to this code highlight the need to develop impact indicators to measure the EE programs in relation to a reduction of threats to conservation aims, and also underline that a common EE indicator set should be built with the support of the central level.

"I think that EE should use indicators that measure the decrease in the threats to the conservation objectives. Currently we have no idea how we can measure it and we have not put it in the guidelines to see which indicators could be possible candidates." (NPS central level)

... "Regarding the evaluation issue, the more evident claim is that the areas have not been able to show the outcomes of EE. Consequently, they asked us to provide a battery of indicators that can be used in this sense." (NPS central level)

... "I think one of the main problems is the impact. We always say, 'we should have an EE strategy', but when considering the practical side, we only have X number of workshops and conferences that cannot be considered real EE. We have to try to find social indicators that measure the impact and consequently analyze which kind of activities we need to test the real impact of EE." (NPS central level)

3.2.2. Networking and participation

Being able to measure participation and networking (inside and outside NPS), is identified by those interviewed as key elements to determine if better results are achieved for EE. More participation from inside and outside entities is also claimed as a way to improve the management and use of financial resources.

... "We have no evaluation method to measure the level of networking, but it is worthwhile to generate it. And not just to have a measure of effort, but as to whether the goal is achieved with or without partnerships ... to see if you get to the same point and how, with an alliance or without." (NGO)

... "We work together with the coordinators of 6 other countries on the subject of the indicators. Each of us makes proposals and we discuss them as a group. Once defined, we all use the same indicators to make our evaluation." (NGO)

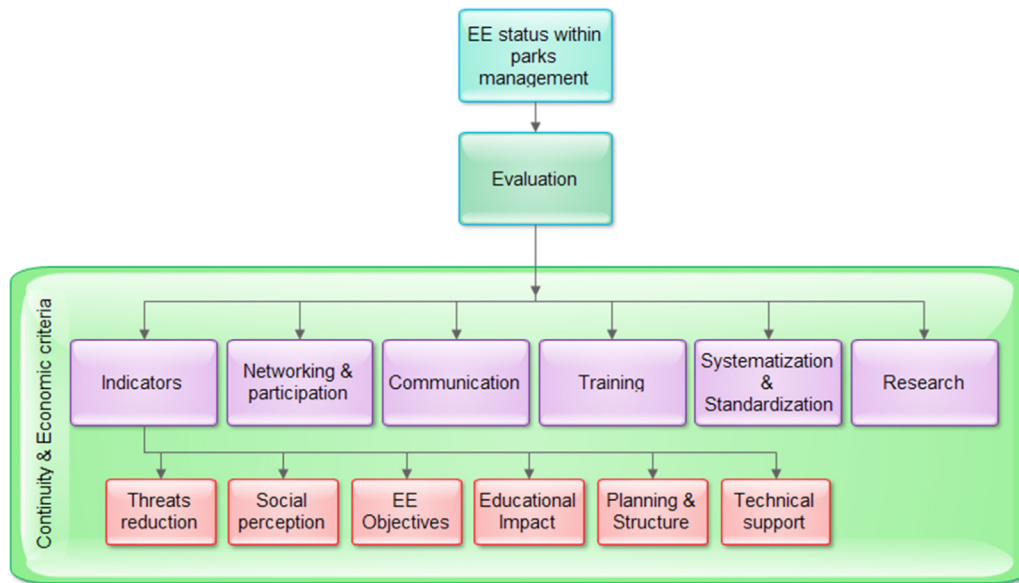


Fig. 2. Interviews: codes ratio appearance within the evaluation category (left) and hierarchical structure generated from the relations among codes (right).

3.2.3. Objectives, structure, systematization and planning

Starting a long-term evaluation process requires: a coherent Institutional structure, clear objectives, a systematization route and a consistent framework to back them up in order to link results to aims and goals for effective management (Bettinger et al., 2010; Saterson et al., 2004).

...“The monitoring report is based on management reports, but when presented, all topics are mixed, and what you have about EE are very incomplete. We have emphasized the need to organize this information in an orderly and detailed manner, specifying the target audience and materials used to get a better idea of what activities they are carrying out at the protected areas.” (NPS central level)

...“Things must be categorized to be clearer about the type of EE you’re looking for and what are the sources that give us the desired results.” (NGO)

...“Management plans should have greater clarity, an overall goal and specific objectives. I do not know much about this issue, but what I see in general terms is that there are many disparate pieces, so there isn’t a projection or a scheme. The non-existence of a big goal or goal targets to achieve, obviously you cannot project methods or actors, you can not set up anything.” (NGO)

3.2.4. Economic criteria, continuity and social perception

Being able to measure the social valuation of the NPS and also the continuity of the EE process is one of the big challenges that arise during the interviews. Continuity appears as a transversal issue within the evaluation category, strongly related to economic criteria, as a constraint factor for the development and progress of the EE program.

...“To the extent that we are able to give continuity to the projects, we can have data from before, during and after the application of the measures. One constraint we have for continuity is that there are not enough financial resources to do so.” (NGO)

...“Much could be measured in the acceptance of the community towards the perception of the park. Examples like the trust that has been gained, people organization, interpersonal

relationships, community service, partners for conservation, etc.” (NPS central level)

3.3. Categorization

EE staff classified objectives into six (6) major categories: promote spaces and networking for EE, communication, sustainable and effective management, training, social valuation and economical sustainability.

3.4. Systematization process – indicators selection

Performing a cross-analysis of results from the questionnaire, interviews and categorization analysis, a set of co-occurring categories was established as a baseline for the indicators development. Three indicators were selected as benchmark from the identified needs, except for training and economical sustainability, that are not competences of the EE program within the structure of the NPS. In some cases, one indicator can be used to provide information for one or more of the defined categories. The remaining two indicators from the general proposal, continuity and program implementation, were developed at the end of the process, as a result of the general review of data analysis and feedback.

3.5. Focus groups

A unique focus group was carried out to evaluate the set of indicators for its integration into the National Park’s management model. This focus group was held as a part of the EE national meeting with representatives of NPS EE staff from all regions of the country, including national, regional and local level.

As a result, the focus group agreed the inclusion model and the set of indicators, with the correspondent names and methodology. However, in relation to the knowledge indicator as defined by Kuhar et al. (2010), it was renamed as information appropriation, to reflect more precisely the context that Parks work with, avoiding confusion and discrepancies about the cultural meaning of knowledge and the way to measure it.

In relation to this measure, a complementary approach was proposed to be developed in the future, to see the progress in the construction of knowledge among participants of EE process. The

Table 1

Indicators set proposal, elaborated and developed in collaboration with the EE and effective management central office of National Parks of Colombia.

• Appropriation of information (impact indicator)

Shows the variation in knowledge related to the concepts associated with the conservation of biodiversity and protected areas, developed by EE processes (Kuhar et al., 2010). Measuring consists of pre-post surveys, with repeated measures over time with the same sample. To detect the impact of the program, an analysis of variance for repeated averages (ANOVA) will apply, assuming that the same individuals will go through the pre-post survey, where the dependent variable is the proportion of people who correctly answered each of the questions of the survey.

• Articulation coherence (impact indicator)

Shows the degree of coherence of the educational actions and processes in relation to the identified risks (García Ventura, 2007).

$$3 * \left(\frac{CR}{TCR} \right) + 2 * \left(\frac{MMR}{TMMR} \right)$$

CR = number of critical risks approached from the EE.

TCR = total critical risks detected, that can be addressed by the EE.

MMR = number of moderate and/or mild risks approached from the EE.

TMMR = total of moderate and/or mild risks detected that can be addressed by the EE.

• Participatory quality (impact indicator)

Measures the participation of stakeholders involved in the management strategies that are supported through environmental education processes.

$$\sum_{i=1}^i \left[\left(\frac{Ao+Pc+Pl}{3} \right) * \frac{Prs}{Pas} \right] * \frac{1}{TNP}$$

Ao = achievement objectives score.

Pc = process continuity score.

Pl = participation level score.

Prs = prioritized stakeholders.

Pas = participating stakeholders.

TNP = total number of processes supported by EE.

• EE continuity (process indicator)

Measures the continuity of the EE educator in relation to objectives achievement and performed activities.

$$C = \sum_{i=1}^{Fi} \frac{Fi}{12} * \frac{Gperf}{Pgoal} * \frac{Oach}{Oini} * 100$$

Fi = educator permanence (months).

Gperf = goals performed.

Pgoal = projected goals.

Oach = objectives achieved.

Oini = initial objectives.

• EE implementation program (process indicator)

Measures the total of areas that are implementing educational processes (formal and informal) within the framework of the National Strategy for EE.

$$LIEE = \frac{PA}{TNPA} * 100$$

LIEE = level of implementation of EE program in %.

PA = protected areas implementing EE.

TNPA = total number of protected areas within the NPS.

articulation and participation indicator, received the green light from participants, and a pilot test is already in progress.

3.6. EE indicator set proposal

Summing up the results, an integrated indicator set proposal was built from the emerging categories, and is presented in Table 1 as a short version. The construction of this indicator set proposal is based in first place of pre-existing indicators, for the case of the appropriation of information and articulation (Kuhar et al., 2010) and coherence indicators (García Ventura, 2007). The interdisciplinary team developed the remaining three indicators. In this final step it is more of an art than a science to determine the appropriate indicators for a given information need (Margoluis and Salafsky, 1998) in which no complex mathematical procedures were needed (Saterson et al., 2004).

A methodology sheet for each indicator was developed to explain in detail the procedure needed to measure the indicators (see supplementary material). The format follows the one established by the NPS quality system. This is a key step for the integration of EE evaluation into the management planning with a tool that facilitates the comprehension and application of the indicator in all the areas (Rode and Michelsen, 2008).

4. Discussion

Quantitative and qualitative results support the need for an evaluation framework for the EE program that goes beyond annual

reports or specific products, supported by the fact that there were no established indicators for EE that allowed measuring of the impact of the program. Similar recommendations were exposed in the last analysis of management effectiveness for the NPS by international experts, in which they highlight the need to identify impact and response indicators that reveal the contribution of institutional actions to the purposes of the system for the conservation of biodiversity (UAESPNN, 2011, p. 131).

Representative voices from EE inside and outside NPS of Colombia gave us the baseline information and first insights on how to address the evaluation issue through the perspective of the people that work in the field, which we discuss in the following sections.

4.1. SMART objectives for SMART indicators

During the analysis, we recognized that in order to develop suitable indicators guided by the SMART concept (see Section 1), is essential to start with SMART objectives to give coherence and viability to the whole process. In other words, both items, objectives and indicators must conserve the SMART elements to succeed.

Survey data, interviews and results from the categorization analysis, agree that a re-definition of objectives was needed before the development of indicators. We coincide with Frascchetti et al. (2002), that one of the major difficulties in quantifying protected areas effectiveness is that reserves generally have multiple or lack clearly defined objectives, that hinders any analysis of management

strategies, which difficult any kind of measurement, as one of the main characteristics of an SMART objective.

The filtering process in the objectives categorization, has led to the staff realizing that EE objectives converge into the same categories from local to national level, helping to making them specific, despite the Park's location and singular conservation aims. This is significant as it implies that it can serve as a replicable model and also for comparing other studies where, although there might be heterogeneity of protected areas conservation aims, educational objectives go in the same direction.

Having clear objectives linked to the updated management plans is in fact a big step for the transmission management programs outside the official documents (Rodríguez-Rodríguez and Martínez-Vega, 2012). The process of developing smart objectives fostered internal networking and institutional planning, helping to visualize the EE as a crosscutting program and catalyzer for management goals (Abdulla et al., 2008, p. 19, 132). This process also improved the status of EE at central level, serving as a benchmark to the rest of the management areas. We recommend this kind of analysis to other crosscutting issues such as the case of gender, to highlight the social dimension for conservation (Fisher et al., 2005).

4.2. Indicators

4.2.1. Appropriation of knowledge

The appropriation of knowledge indicator was developed by Kuhar et al. (2010) and is suitable to be included in our indicators set proposal. This measure groups put together the requirements we were looking for, however small changes were made to adapt into the NPS reality.

It is worth noting that during the focus group, it was proposed to develop in the future, an indicator to measure progress in the joint construction of knowledge. This suggestion could be of special interest in regions where ancestral and scientific knowledge co-occur and clash with management strategies. A participative and inclusive common knowledge could help to understand the dynamics of local communities and facilitate public participation in the evaluation process (Fisher et al., 2005, p. 25). Measuring the evolution of this process could be of particular importance to save and protect traditional knowledge as a common heritage, and include it as one of the conservation aims of places where this knowledge still remains.

4.2.2. Articulation-coherence and participation quality

In addition, articulation and participation quality indicators were adapted and developed respectively to measure different EE objectives such as networking (internal or external), participation, and communication to achieve sustainable management within the protected areas. Complex situations, as social issues are, require several pieces of data to be fully understood, in which a given objective can have multiple indicators (Margoluis and Salafsky, 1998, p. 89), or cases in which one indicator can provide data to assess different objectives. This is usually represented in an objective-indicator matrix, where indicators are expected to be complementary, according to the project approach (Pomeroy et al., 2004, pp. 47, 53, 117, 164).

The articulation indicator (García Ventura, 2007) shows the degree of coherence of the educational actions and processes in relation with the identified risks for the protected area. It gives information about how relevant are the educational processes carried out in relation to management objectives, and provides an insight into how management programs (EE, monitoring, surveillance, research, etc.) interact to achieve a common goal.

The indicator of participatory quality was developed to transform qualitative process data into a quantitative tool. It measures prioritized stakeholders' inclusion (see [supplementary material](#))

according to conservation objectives and their involvement within EE processes. This indicator supports the recommendation made by international experts in terms of participation for the NPS (UAESPNN, 2011, p. 91). We also think that this indicator could provide extra valuable information if at the end it is also correlated with other biological indicators from the monitoring area (Bettinger et al., 2010).

Improving networking, communication, and participation from internal and external levels, are key issues to achieve conservation success in protected areas (Hesselink et al., 2007, p. 51). These two indicators incorporate qualitative data and social variables that will improve and give support in the systematization (Saterson et al., 2004), monitoring, and evaluation of EE within the management plans.

4.2.3. Continuity and program implementation

The program implementation indicator was already defined to evaluate the progress of the EE among protected areas and the advancement of the program in relation to the rest of management programs of the NPS. It was internally socialized in the management-planning group, however its content and structure was improved in order to be included in the set of EE indicators.

The continuity indicator was elaborated at the end of data gathering and participative processes. This indicator arose from a national perspective analysis about the gaps that still existed for the final indicators set proposal. The emerging challenge was to link objectives and achieved goals in relation to the permanence of the EE person/team assigned to such objectives. This measure will show the effects of discontinuity on the accomplishment of objectives and the processes development, a common harmful situation within this field. Attention to the continuity of (Mayer, 2006) recruitment and stability of EE staff and programs remains a major constraint for the progress of the EE program (UAESPNN, 2011, p. 114; Zorrilla-Pujana and Rossi, 2014), with this proposal representing a first step to measure the effects of this rooted weakness with real data.

The inclusion of both indicators for national level use (central office) does not discredit the research design that wanted to include the bottom-up perspective, without forgetting the top-down view, being two complementary processes. In social research practice, processes such as data collection and analysis are rarely distinct or sequential tasks. Indeed, a significant advantage of the qualitative approach is its flexibility in allowing the researcher to move back and forth in a cyclical way as the discovery of theoretical insights prompts adjustments in the research design (Gerson and Horowitz, 2002, p. 200).

4.2.4. Economical sustainability and training

Economical sustainability of the EE program and staff training on EE competences did not have an associated indicator as those thematic lines were out of the competences of the EE program, and also beyond the scope of this paper. However we want to highlight the need to foster both issues for the stability and progress, not only for the EE strategic line but also for the performance of the protected areas system (Watson et al., 2014). The success of any educational initiative is linked to the effectiveness of its delivery which requires training and coaching (Bettinger et al., 2010), and it should be considered as an essential component not only for EE but for all management staff.

4.3. Participative process

Initially, the indicators' development was designed to be participative at all stages (Fontalvo-Herazo et al., 2007; Ramos and Caeiro, 2010). We decided not to involve all of the EE team in the whole indicators construction process, because we found a lack of

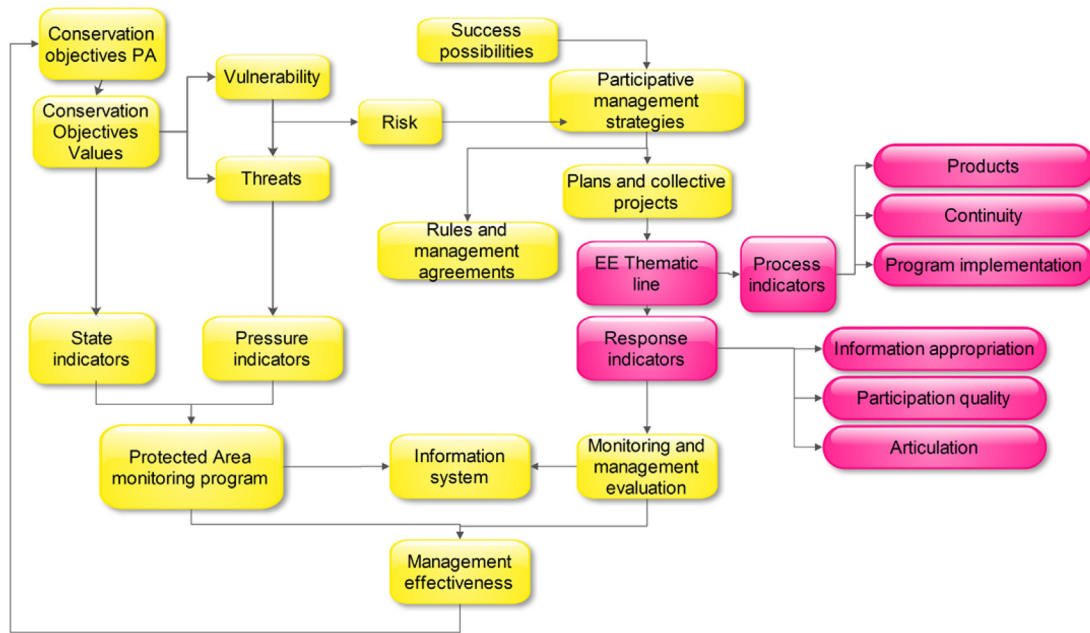


Fig. 3. The set of EE indicators included in the management model for the National Park System. This is the contribution of this research to the EE thematic line, having two indicator's typology: response and process.

competences and skills needed to advance in the analysis. Coinciding with [Elbroch et al. \(2011\)](#), sometimes it is unrealistic to aim for incorporation of local experts into the complete research process when knowledge, technical literacy or specific expertise is needed.

A practical session with researchers, EE practitioners, and the leader from evaluation of management effectiveness, was an added value task to assist final users to get used to the indicators. It helped to solve questions during the indicators testing exercises, and helped to improve the methodological sheet. This practice is important to provide a space to discuss aspects that may be logistically difficult or culturally problematic for its application ([Bettinger et al., 2010](#)). The practical work also served as a way to gain support for the indicators set proposal, by seeing for themselves the usefulness of the measures within their local EE plans.

Effective evaluation of EE programs requires expertise from multiple fields. Training, collaboration and partnerships are necessary to build an appropriate knowledge base, to inform across natural and social dimensions for a more effective management of biodiversity recovery ([Fisher et al., 2005](#); [Lundquist and Granek, 2005](#); [Moon and Blackman, 2014](#); [Pooley et al., 2014](#)). We coincide with [Ibrahim et al. \(2011\)](#), that teamwork was essential for the success of the elaboration of this indicators set, resulting in visible, practical and effective collaboration. Establishing dialog across typical boundaries with managers, conservation practitioners, stakeholders and academics ([Popescu et al., 2014](#)), is the manner in which we can effectively use conservation education to positively impact on the many endangered species and habitat around the world ([Brewer, 2006](#); [Kuhar et al., 2010](#); [Laurance et al., 2012](#); [Sherrow, 2010](#)).

4.4. Indicators for practice

The simplicity, ease of understanding, and usefulness of the indicators, combining rigor and accuracy, has lead to a favorable implication and integration within the protected areas strategic plans by the EE staff ([Reed et al., 2008](#)). The proposal was well received from other entities such as NGOs that agree that the indicators are very comprehensive and easy use for EE practitioners, if compared to other kind of measures from the qualitative point of

view. They stated that these indicators could also be useful as a prioritization and coordination tool for incoming projects to the NPS, helping to provide a quick answer and support to those initiatives that best suit the identified needs of the areas. External users from NGOs stated that their use could also be extrapolated to their work and not strictly within the NPS scope.

This indicators set makes it possible to compare results individually among different NPS from similar contexts and sum result of the same hierarchical level as required from managers and decision-makers. The ability to compare protected areas on objective, simple and meaningful bases over time is increasingly demanded, but few systems have been developed so far ([Rodríguez-Rodríguez and Martínez-Vega, 2012](#)).

Indicators are powerful tools in the feedback loop of an action plan, and as an early warning signal about an emerging problematic issue, or in providing a concise message for engagement, education and awareness ([Blumstein and Saylan, 2007](#); [IOC-UNESCO, 2006](#)) However, indicators must come together with an analysis and interpretation of the resulting data from the EE staff to convert it into valuable information during the evaluation and decision-making process ([Ramos and Caeiro, 2010](#); [Segnestam, 2002](#); [Tilbury et al., 2007](#)).

It is expected that this theoretical indicator's proposal could be integrated into the management model as an essential piece ([Fig. 3](#)) to understand that EE programs are not quick fixes, but rather as a long-term investment ([Sherrow, 2010](#)). Improving the evaluation process will allow one to visualize the impact of the EE actions, both successes and failures ([Stern et al., 2013](#)). Having information on these measures at the end of a management plan will provide backing to the hypothesis that EE process with satisfactory indicator values helps to improve the state of the conservation value. Only in this way, will EE find its corresponding place within conservation policies and budget assignments in the management of protected areas.

5. Conclusions

Environmental governance is also about education. This management variable must go beyond the establishment of laws,

scientific knowledge sharing, and cooperation. A general need to increase social participation in the management process is evident and valuation of this involvement must be included in governance issues. With this research we should give a baseline to start this process.

An institutional shift in the conception of management indicators has occurred, in which qualitative measures through the EE program appear as one solution to a large gap in response indicators within the management model in the NPS. This research has generated new insights to improve EE evaluation inside NPS of Colombia, giving a clear, practical and participatory framework for the development, integration and application of process and impact EE indicators for the new management plans of protected areas.

Starting a long-term evaluation process is also a commitment to accomplish the stated objectives of the EE, with a more social focus, providing continuity to environmental conservation policies. This is one of the big challenges that NPS will face in the following years, putting into practice the powerful mission the institution has.

We expect that this methodological approach for evaluation, from a bottom up perspective, could help other EE practitioners to improve their evaluation task, and recognition of EE process as fundamental for protected areas management, with a methodology of easy adaptation and replication in other countries.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ecolind.2016.02.053>.

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