

Integrated Biodiversity Management, South Caucasus

Biodiversity Monitoring



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Executive summary

Biodiversity is significantly declining worldwide, having a negative impact on human well-being. To record these changes and effectively respond, it is required to comprehensively monitor components of biodiversity, anthropogenic and/or natural factors and environmental policies. In many countries, including Armenia, the absence of national biodiversity monitoring system is an obstacle for effective decision-making for biodiversity conservation and negatively impacts on development of national environmental policies. The RA Strategy on Conservation, Reproduction and Use of Biological Diversity and National Action Plan for 2016-2020, which was approved by the Government of RA in 2015, is also stated that not sufficient survey and monitoring of biodiversity components is obstacle for implementation of the National Biodiversity Strategy and Action Plan. Thus, establishment of national biodiversity monitoring system is crucial for conservation of threatened species and ecosystems, sustainable use of natural resources, as well as fulfilment of the commitments undertaken by Armenia towards international conventions.

The main goal of this brochure is to present main terms and definitions related to biodiversity monitoring, basis for establishment of national biodiversity monitoring system and the requirements of national legislation and commitments undertaken by Armenia to the international conventions.

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List of Abbreviations

| | |
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| SPNA | Specially Protected Nature Area |
| NGO | Non-Governmental Organization |
| RA | Republic of Armenia |
| PSR | Pressure-State-Response |
| UN | United Nations |
| UNEP | United Nations Environmental Programme |
| CBD | Convention on Biological Diversity |
| CEPA | Communication, Education and Public Awareness Programme |
| CSD | Commission on Sustainable Development |
| EEA | European Environment Agency |
| OECD | Organization of Economic Cooperation and Development |
| SBSTTA | Subsidiary Body on Scientific, Technical and Technological Advice |

1. Introduction

Biodiversity is significantly declining worldwide, having a negative impact on human well-being. To record these changes and effectively respond, it is required to comprehensively monitor components of biodiversity, anthropogenic and/or natural factors and environmental policies. In many countries, including Armenia, the absence of national biodiversity monitoring system is an obstacle for effective decision-making for biodiversity conservation and negatively impacts on development of national environmental policies. The RA Strategy on Conservation, Reproduction and Use of Biological Diversity and National Action Plan for 2016-2020, which was approved by the Government of RA in 2015, is also stated that not sufficient survey and monitoring of biodiversity components is obstacle for implementation of the National Biodiversity Strategy and Action Plan. Thus, establishment of national biodiversity monitoring system is crucial for conservation of threatened species and ecosystems, sustainable use of natural resources, as well as fulfilment of the commitments undertaken by Armenia towards international conventions.

The main goal of this brochure is to present main terms and definitions related to biodiversity monitoring, basis for establishment of national biodiversity monitoring system and the requirements of national legislation and commitments undertaken by Armenia to the international conventions.

2. Main principles of biodiversity monitoring

2.1 Main principles and attributes

The main objectives of biodiversity monitoring are providing information on its current state and trends, justification for environmental policy and decision-making, as well as the evaluation of environmental impacts. First, it is important to differentiate the inventory and cadastre from the monitoring procedure. The inventory is the stock taking of data presented at a certain point of time, and the monitoring is how the inventory changes throughout time. Monitoring also observes the processes that make these changes.

At the initial stage of the establishment of the biodiversity monitoring system, it is extremely essential to clearly define the goals and objectives of the monitoring, identify the key stakeholders and design (participatory) biodiversity monitoring system and the model of indicators. It is also important to outline the end-user of data and the main purpose of use. In the process of design of biodiversity monitoring system, it is desirable to take into account some of the attributes that are presented in the Table 1.

Monitoring can be general (surveillance) or effectiveness monitoring. The surveillance monitoring is characterized by a long-term monitoring of biodiversity indicators, that may have take dozens of years and is aimed to identify profound environmental issues and serve as a basis for strategic planning. The effectiveness monitoring considers the effectiveness of certain actions during short (several years) period, such as the monitoring of the effectiveness of conservation measures or projects (Plattner, 2015; Werner & Gallo-Orsi, 2016).

The decisions on the monitoring of the flora and fauna (Annex of the RA Government decision N 120-Ն and N 121-Ն, 2009), approved by the Government of RA, propose the following stages of the monitoring:

- Obtaining and collecting baseline data through observation of monitoring objects,
- Analyzing, summarizing and forecasting of obtained data,
- Maintaining and providing of information,
- Developing draft decisions on the implementation of environmental activities based on monitoring data by the authorized state body with the participation of other stakeholders (territorial administration bodies, relevant self-governing bodies, non-governmental organizations, environmentalists, etc.).

Forest monitoring procedure includes data collection, recording, analysis, summarization, forecasting, classification, and indication of negative impacts, managing database and providing reports (Annex of the RA Government decision 198-Ն).

To establish and implement biodiversity monitoring at the national level, the UN Convention on Biological Diversity proposes the following stage-by-stage process:

- Defining the goals and objectives of the environmental policy;
- Developing relevant indicators
- Preparing proper monitoring plan that will enable to achieve progress towards the objectives of environmental policy.

In addition, various guidelines (Plattner, 2015; Werner & Gallo-Orsi, 2016) offer the following key stages for the monitoring program development:

- Identification and engagement of key stakeholders,
- Clear definition of goals and objectives, national and international legislation analysis, determination of approaches and concept of monitoring procedure,
- Selection of priority areas for monitoring,
- Selection of indicators: analysis of existing biodiversity indicators, definition of selection principles, indication and selection of indicators,
- Data collection, management, analysis and reporting, sampling and data collection methods, clarification of methodological approaches and procedures, data management and maintenance,
- Preparation of monitoring: identification of responsible persons and participants, capacity building and training of participants, creation of working plan and program, secure of funding,
- Implementation and institutionalization of the monitoring system.

2.2 Pressure-State-Response (PSR) model

An indicator is commonly defined as a measure based on verifiable data that conveys information about more than itself (Werner & Gallo-Orsi, 2016). The indicators should summarize and clarify complex data based on comparable scientific observations and statistical measurements as well as have a clear message that can be used for decision-making (UNEP/CBD/SBSTTA/9/10, 2003). The state indicators of biodiversity (species richness, composition) by themselves are not enough for understanding of natural/anthropogenic impact, which reflect on state of biodiversity and further effective decision-making and management intervention (Werner & Gallo-Orsi, 2016).

The Pressure-State-Response (PSR) indicators model assesses anthropogenic/natural **pressure** on the **state** of the environment and **response** in the form of policy decisions and management interventions to return the "desired state of environment" (Figure 1) (Levrel *et al.*, 2009). The PSR model incorporates pressure, state and response indicators that are correlated with causal linkage. The PSR indicators model was designed by the Organization for Economic Co-operation and Development (OECD, 1994). Then, based on this concept, several similar models have been developed and proposed by different organizations, such as the Driver-Pressure-State-Impact-Response (EEA, 2003); Driving Force-State-Response (CSD, 2001). The UN Convention on Biological Diversity recommends Pressure-State-Use-Response-Capacity model, which in

addition to the PSR model, also consider capacity and use of biodiversity by human (UNEP/CBD/SBSTTA/9/10, 2003).

Pressure indicators define the primary stage of the environmental issue, anthropogenic/natural impact. Indicators of pressure on biodiversity can be for example: forest management intensity, landscape fragmentation, overgrazing, land degradation for agricultural purposes, loss of valuable habitat, etc.

State indicators are defined as status of environment (biodiversity) resulting of anthropogenic/natural pressure factors. Thus, for designing the indicators, it is important to consider that state indicator should be sensitive and respond to pressure. State indicators are species and genetic diversity, flagship species, species registered in the Red Book, invasive species, ecosystems, habitats, etc.

Response indicators define the reaction of the public/decision makers that reduces the negative impact of the pressure factors causing the change in the state of environment. Indicators of response are extension of Specially Protected Nature Areas, environmental policy change and legislative reforms, increasing of funding for environmental activities, raising of awareness and etc.

An example of PSR model: The natural ecosystem is transformed into agricultural land, which is an anthropogenic pressure. As a result, the habitats of endangered species and indicator species are reduced. Thereby, the state of the species and their habitats is changed. Response to this change is creation of Specially Protected Nature Areas or to extend the existing NSPA, otherwise to change the current environmental policy in order to maintain that natural ecosystems.

The standards and principles of the design and selection of indicators are crucial. For this purpose, the UN Convention on Biological Diversity has prepared the following criteria for the design of indicators at the national level:

According to CBD, the indicators should be:

- **Policy relevant and meaningful:** Indicators should send a clear message and provide information at a level appropriate for policy and management decision making by assessing changes in the status of biodiversity (or pressures, responses, use or capacity), related to baselines and agreed policy targets if possible.
- **Biodiversity relevant:** Indicators should address key properties of biodiversity or related issues as state, pressures, responses, use or capacity.
- **Scientifically sound:** Indicators must be based on clearly defined, verifiable and scientifically acceptable data, which are collected using standard methods with known accuracy and precision, or based on traditional knowledge that has been validated in an appropriate way.
- **Broadly accepted:** The power of an indicator depends on its broad acceptance. Involvement of the policy makers, and major stakeholders and experts in the development of an indicator is crucial.

- **Based on affordable monitoring:** Indicators should be measurable in an accurate and affordable way and part of a sustainable monitoring system, using determinable baselines and targets for the assessment of improvements and declines.
- **Based on affordable modelling:** Information on cause-effect relationships should be achievable and quantifiable, in order to link pressures, state and response indicators. These relation models enable scenario analyses and are the basis of the ecosystem approach.
- **Sensitive:** Indicators should be sensitive to show trends and, where possible, permit distinction between human-induced and natural changes. Indicators should thus be able to detect changes in systems in time frames and on the scales that are relevant to the decisions, but also be robust so that measuring errors do not affect the interpretation. It is important to detect changes before it is too late to correct the problems being detected.

The CBD also presents available and potential indicators reported by 52 Parties and other Governments here: <https://www.cbd.int/indicators/testedindicators.shtml>

In addition, the CBD prepared set of key questions, which can help during initial stage of indicators development. They define issues, which should be addressed and monitored by state, pressure and response indicators, as well as questions, which should be answered through indicators (UNEP/CBD/SBSTTA/9/10). You can find the set of key questions here: <https://www.cbd.int/indicators/questions.shtml>

It should be noted that within the framework of the UN Convention on Biological Diversity, the Biodiversity Indicators Partnership (<https://www.bipindicators.net>) initiative has been established, which supports the Convention and its Parties to design the indicators. Biodiversity Indicators Partnership has developed guidelines for designing indicators where detailed design and use of indicators are presented:

https://www.bipindicators.net/system/resources/files/000/002/191/original/Framework_Brochure_UK_0311_LOWRES_%281%29.pdf?1481634262

The Caucasus Biodiversity Monitoring Network has developed some indicators for monitoring of the Caucasus Ecoregion, including activities of the Armenian NSPA's and the condition of the forests. The Caucasus Biodiversity Monitoring Network is a biodiversity long-term monitoring system that promotes the implementation of the goals of the Convention on Biological Diversity in the region (<http://www.wwfcaucasus.net/Index.aspx>).

2.3 Participatory biodiversity monitoring

Participatory implementation of biodiversity monitoring emphasizes the engagement of key stakeholders in the initial phase of the monitoring system design. The participatory monitoring system unlike of state bodies may also include, the local population, non-governmental and international organizations, scientific institutions, the private sector, and other relevant stakeholders. Participatory monitoring of biodiversity

has both strong and weak sides. Particularly, the participatory system enables engagement and raising awareness of local communities, obtaining of support from NGOs, local communities for implementation of nature conservation projects, using knowledge accumulated by local people and other stakeholders, reducing the implementation and maintenance costs of biodiversity monitoring system. Meanwhile, there are also disadvantages in the participatory approach, some of the sampling and research methods require expertise and involvement of specialists, it is also necessary to enhance capacity and knowledge of the participating organizations, as well as periodic change of participating organizations may have a negative impact on the performance. An important part of the participatory monitoring system is the citizen science, considering general public, volunteers, and others who can submit their observations through online platforms (web sites, Facebook groups, such as Birding Armenia) (Werner & Gallo-Orsi, 2016):

Table 1 Some of the primary attributes of biodiversity monitoring (Pocock *et al.* 2015)

| Some attributes for biodiversity monitoring |
|--|
| There is a standardized methodology and protocols to ensure consistency |
| There are suitable field sampling methods that are accurate or efficient |
| There is national or regional coordination |
| There are data systems (e.g. online) for efficient data capture and storage |
| There are quality assurance checks undertaken in order to ensure the accuracy of the records |
| There are appropriate analytical or statistical approaches to measure trends from monitoring data |
| There is good retention of contributors |
| There is a scientific scheme design (such as stratified or randomised site selection) for statistical rigour |
| There are simple ways for everyone to report widespread or common or easily-identified species |
| "Important" or "indicator" species have been identified |
| There is wide coverage across the country or region e.g. covering remote and well-populated regions |
| There are systems for electronically capturing data in the field |

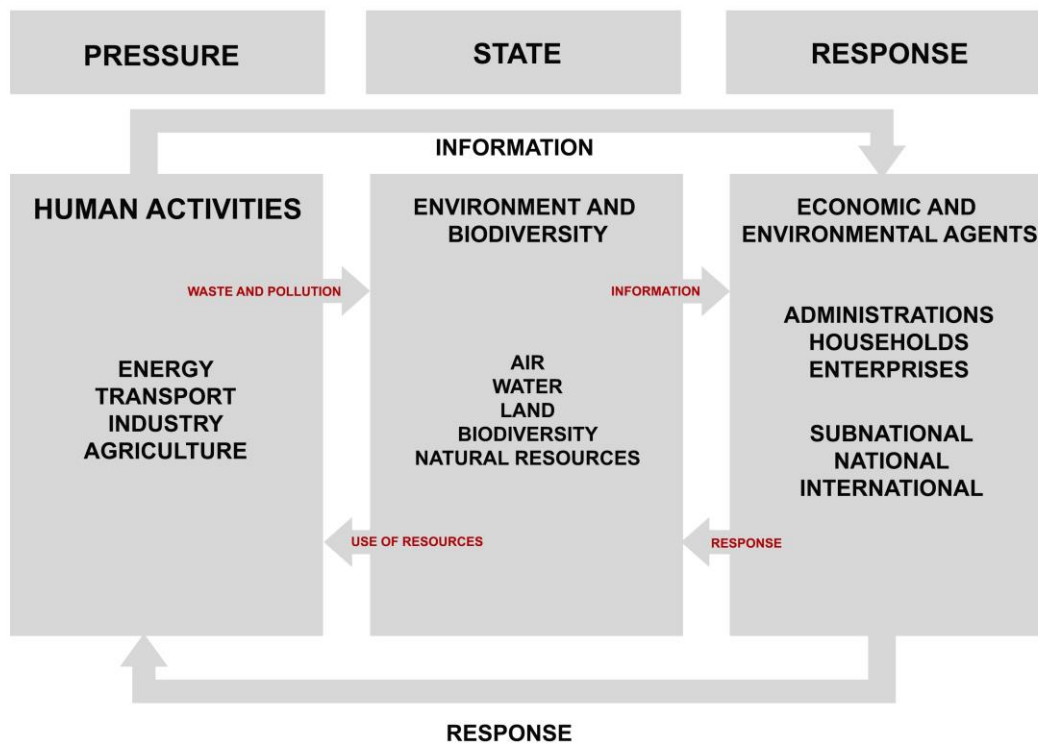


Figure 1 Pressure-State-Response model

3. The requirements of RA national legislation and international commitments

3.1 The requirements of RA national legislation

The requirements, procedures and strategies for environmental and biodiversity monitoring in the RA legislation are mainly presented in the Annex to the decision N 19 of the RA Government (2006) and in a number of other decisions.

The following principles are stated for the state environmental (biodiversity) monitoring:

- Temporal continuity
- Implementation of common policy
- Ensuring implementation of international commitments of the Republic of Armenia
- Availability of information on state monitoring

The main conditions of the state environmental monitoring are:

- Legal and regulatory provision, including compliance with environmental standards and indicators, which are derived from the objectives of monitoring and determining mechanism of its information collection, processing, analysis,
- Ensuring implementation of stable and continuous processes of collection, processing, analysis, protection and provision of information,
- Ensuring scientific and technological base taking into account advanced technologies and tendencies
- Ensuring sustainable financing of monitoring implementation and data analysis.

On the territory of RA, except the forests and forest lands (under the jurisdiction of the RA Ministry of Agriculture) the monitoring of flora and fauna are carried out by the Ministry of Nature Protection of the Republic of Armenia and in the forests and forest lands by the RA Ministry of Agriculture. The regulations for the organization and implementation of the flora and fauna monitoring indicate that the basis for the monitoring of flora and fauna is data of the state cadastre. For animals, data of the cadastre is collected no later than five years, and for plants no later than ten years. In some cases, if needed it can be implemented based on the RA Government decision (Annex of the RA Government decision N 120-Ն and N 121-Ն, 2009). In the Specially Protected Nature Areas of Armenia, basis for the monitoring is the inventory and cadastre of flora and fauna (Annex of the RA Government decision N 1044-Ն, 2007). The above-mentioned decisions of the Government of RA, present the detailed procedure for the organization of monitoring of flora, fauna and NSPA's. The state monitoring of forests is carried out by the Ministry of Agriculture of the RA and aimed to create and implement the state forest policy and strategy, programs and ensure sustainable forest management. (Annex of the RA Government decision N 198-Ն, 2007).

In 2015, the Government of RA approved the RA Strategy on Conservation, Reproduction and Use of Biological Diversity and the National Action Plan 2016-2020. They aim to promote the implementation of the UN Convention on Biological Diversity Strategic Plan for Biodiversity 2011-2020 (2010) and Aichi Biodiversity Targets. It includes biodiversity research and monitoring activities. In particular, the 5.3.3 of the National Action Plan envisages organizing seminars on biodiversity monitoring in 2016-2020 for introduction of the biodiversity monitoring system.

3.2 The UN Convention on Biological Diversity

In 1992, the Article 7 of the UN Convention on Biological Diversity addresses the issues of identifying and monitoring of biodiversity components, in particular,

- (a) Identify components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories set down in Annex I: **Ecosystems and habitats:** containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance: or, which are representative, unique or associated with key evolutionary or other biological processes. **Species and communities** which are: threatened: wild relatives of domesticated or cultivated species; of medicinal, agricultural or other economic value; or social, scientific or cultural importance: or importance for research into the conservation and sustainable use of biological diversity, such as indicator species. **Described genomes and genes** of social, scientific or economic importance.
- (b) Monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (a) above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use;
- (c) Identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques; and
- (d) Maintain and organize, by any mechanism data, derived from identification and monitoring activities pursuant to subparagraphs (a), (b) and (c) above.

Following the adoption of the Convention, the Conference of the Parties adopted a series of decisions promoting the introduction and implementation of the National Biodiversity Monitoring System, which can be found here: <https://www.cbd.int/indicators/decisions.shtml>

It should also be mentioned that within the framework of the UN Convention on Biological Diversity, Strategic Plan for Biodiversity 2011-2020 (2010) calls on the parties to contribute to the creation and use of scientific information, monitoring the state of biodiversity, ecosystem services and trends, developing initiatives and methodologies,

sharing information, developing indicators, implementing measures, regular and up-to-date assessments.

4. Terms and basic definitions

4.1 Biological diversity

Biodiversity: "Biological diversity" means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Convention on Biological Diversity (1992)

Biodiversity: The variety of life at every hierarchical level and spatial scale of biological organizations: genes within populations, populations within species, species within communities, communities within landscapes, landscapes within biomes, and biomes within the biosphere.

Wilson (1988)

4.2 Monitoring

General term for monitoring: Monitoring, defined as the collection and analysis of repeated observations or measurements to evaluate changes in conditions and progress towards meeting a management objective.

Elzinga *et al.* (2001)

Environmental monitoring: the continuous or frequent standardized measurement and observation of the environment (air, water, land/soil, biota), often used for warning and control.

The Organization for Economic Co-operation and Development - OECD (2007)

Environmental monitoring: Environmental monitoring is defined as an action under permanent or periodical order, including regulated sampling, observation and inspection of environmental conditions, natural events, human-induced environmental changes, consequences and predictions for creation, evaluation and provision of information. The main goal of environmental state monitoring is to create, supply and store information of the state importance.

Annex of the RA Government decision N19 (2006)

Biodiversity monitoring: It is defined as the systematic and focused observation and measurement of changes of biodiversity in its various forms (genes, species, habitats).

Plattner (2015)

Biodiversity monitoring: Biodiversity monitoring is the organized collection of data and information over time to aid the understanding of trends and status in biodiversity. The information may be used in management planning and decision-making.

Trinh *et al.* (2016)

Participatory biodiversity monitoring (PBM): PBM is an approach to biodiversity monitoring that aims to engage different stakeholders, from national government down to the grassroots level. PBM has the potential to create and stimulate dialogue between State and non-State actors on conservation priorities, resource use and forest management interventions.

Trinh *et al.* (2016)

State monitoring of flora: State monitoring of flora is implemented for plant habitats and status of ecosystem. State monitoring is a prediction system of qualitative and quantitative indicators, evaluation of distribution, rapid response and developing of the process for objects of flora.

Annex of the RA Governmental decision N 120-Ư (2009)

State monitoring of fauna: Fauna monitoring promotes conservation of animals and regulation of norms of sustainable use. The monitoring is prediction system of qualitative and quantitative indicators, rapid response and development of the process for objects of fauna.

Annex of the RA Government decision N 121-Ư (2009)

Monitoring of Specially Protected Nature Areas: Monitoring of specially protected nature areas is prediction system of SPNA ecosystems, objects of flora and fauna, their qualitative and quantitative indicators, habitats, natural resources, existing historical monuments, rapid response and developing of the process.

Annex of the RA Government decision N 1044-Ư (2007)

State forest monitoring: The state forest monitoring consists of observation, research and evaluation processes for prediction of the status of forests and forest lands, which is aimed to reveal anthropogenic and natural impacts on forest conservation, protection, restoration and forest use, to prevent illegal logging, transportation of timber and realization, to secure transparency of these activities through rising of public awareness.

Annex of the RA Government decision N 198-Ն (2007)

General baseline monitoring: more general, broad range monitoring, covering several species or habitats (“descriptive”).

Plattner (2015)

Effectiveness monitoring: focused on the effect of specific actions; results needed to improve protective measures (“question-driven”)

Plattner (2015)

4.3 Indicator

Indicator: Information based on measured data used to represent a particular attribute, characteristic, or property of a system.

Millennium Ecosystem Assessment (2005)

Indicator: An indicator can be defined as a ‘measure based on verifiable data that conveys information about more than just itself’. This means that indicators are purpose dependent - the interpretation or meaning given to the data depends on the purpose or issue of concern.

CBD Biodiversity Indicators Partnership

Pressure includes indirect or direct human-induced pressures that affect biological diversity. Indirect pressures are related to demography, economy, technology, culture and governance. Direct pressures include inter alia land use, alien invasive species, climate change, emissions of nutrients and pollutants, fragmentation, exploitative human uses.

State is the abiotic state of soil, air and water, as well as the state of the biological diversity at ecosystem/habitat, species/community and genetic level. State includes ecosystem goods and services, the direct benefits of biodiversity and the societal impacts of biodiversity loss.

Responses are the measures taken to change the state, pressure or use. They include measures to protect and conserve biodiversity in situ and ex situ. They include measures to promote the equitable sharing of the monetary or non-monetary gains arising from the utilization of genetic resources. Responses also include steps taken to understand the causal chain and to develop data, knowledge, technologies, models, monitoring, human resources, institutions, legislation and budgets required to achieve the objectives of the Convention on Biological Diversity.

UNEP/CBD/SBSTTA/9/10 (2003)

Biodiversity indicator: Measurable biodiversity features that describe the quantity and quality of aspects of biodiversity, ecosystem health, services and drivers of change.

Biodiversity pressure indicator: Biodiversity pressure indicators are indicators of the effects, positive and negative, of natural events and human activities on the biodiversity.

Biodiversity state indicator: Biodiversity state indicators directly show the status of and trends in biodiversity elements.

Biodiversity response indicator: Biodiversity response indicators are indicators of the efforts to conserve biodiversity - interventions to mitigate the perceived pressure on biodiversity.

Trinh *et al.* (2016)

Indicator species: A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem.

Biodiversity glossary (CBD CEPA toolkit project)

4.4 Other terms

Baseline study: Work done to collect and interpret information on the condition/trends of the existing environment.

United Nations Environment Programme - UNEP (2002)

Inventory: On-site collection of data on natural resources and their properties.

Biodiversity glossary (CBD CEPA toolkit project)

State cadastre of flora: The state cadastre of flora is an informational and documental system of objects of flora on quantitative and qualitative characteristics of legal regime, status, environmental, cultural and economic values, regional and country distribution, resources and their usage.

Annex of the RA Government decision N 1440 (2008)

State cadastre of fauna: The state cadastre of fauna is an informational and documental system of objects of fauna on quantitative and qualitative characteristics of legal regime, status, environmental, cultural and economic values, regional and country distribution, resources and their usage.

Annex of the RA Government decision N 1441 (2008)

State cadastre of specially protected nature areas: The state cadastre of specially protected nature areas is continuously filled with an informational and documental database of geographic placement of given area, boundaries, protection regime, biological diversity, state of natural resources, property forms of users of natural resources, quantitative and qualitative characteristics of scientific, economic, social and historical values.

Law of the RA on specially protected nature areas (2006)

State inventory of fauna: The state inventory of the entire territory of the Republic of Armenia ensures receipt of information about wild animal species, which is required for management of state cadastre of fauna and implementation of monitoring.

Annex of the RA Government decision N 975-Ն (2009)

State inventory of flora: The state inventory of the entire territory of the Republic of Armenia ensures receipt of information about wild plant species, which is required for management of the state cadastre of flora and implementation of monitoring.

Annex of the RA Government decision N 974-Ն (2009)

5. Conclusions

During preparation of this brochure, the RA and international legislation, related scientific articles, reports and other documents have been analysed. The implemented analysis has revealed, that in the first stage of introduction of the biodiversity monitoring system in the RA, it is necessary to revise and unify the legal framework regulating biodiversity monitoring. It is also important to the form model for implementation of monitoring, data collection, storage and analysis, as well as to establish united coordinating body. In order to increase effectiveness of biodiversity monitoring and reduce implementation costs, we emphasize introduction of participatory management approach, which will allow engaging of various organizations from state, public, international organizations and other relevant stakeholders.

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