

DEVELOPING INFORMATION SYSTEMS AND PRODUCTS FOR GOVERNMENT BIODIVERSITY POLICY AND REPORTING – Tools and guidance

Access the guide and tools at www.wcmc.io/info-systems-tool



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CONTENTS

1. Purpose and sections of this guide	4
2. Tools	6
3. Suggested steps for projects to develop biodiversity information products and capacity with a system approach	8
4. Specification template examples	14
5. Case study of information system development	29
6. References and resources on biodiversity information development	33
7. Useful knowledge for developing biodiversity information systems and products	35

1. PURPOSE AND SECTIONS OF THIS GUIDE

Guide purpose

This guide is designed to support government staff so that they have the information necessary to make effective decisions on biodiversity. It also provides tools that can be used to strengthen this process.

If followed, the guide and these tools should help establish a system that organizes how biodiversity information is produced, how it is analyzed and how it is made available to people.

Guide sections

Section 1 introduces the purpose and content of the guide and introduces an information system approach.

Section 2 presents a tool and templates to support people as they develop information products and systems.

Section 3 provides suggested steps for developing biodiversity information products and capacity. It follows a system approach through the use of the tools and templates.

Section 4 presents templates, with example content, for specification of a whole information system, an indicator or a database.

Section 5 gives an example of the application of the development steps for an information system.

Section 6 lists references and additional resources for developing biodiversity information for policy.

Section 7 provides useful knowledge for developing biodiversity information systems and products such as indicators.

The tools presented in Section 2 can be used directly with reference to this guide as needed. For non-experts in information system design, it is recommended to first study the useful knowledge in Section 7 and then the suggested project steps Section 3.

These materials are also for the staff of academic institutes and non-government organizations (NGOs) that work with government in the production of biodiversity-related data and analyses.

Why the guide and tools were developed

These materials are produced by the UN Environment Programme World Conservation Monitoring Centre ([UNEP-WCMC](#)) as part of its work to support governments around the world as they work to improve the indicators and analyses that they use for biodiversity policymaking and reporting.

The materials have been developed in response to several common challenges faced by government agencies in having information for biodiversity policy:

- *Lack of suitable indicators* – Indicators can help measure, understand and communicate topics and targets, but they are often not available, or are not specific enough.
- *Lack of suitable data* – The data sets necessary to produce indicators, spatial analyses, and reports often do not exist, or are inaccessible, or are not relevant for the need, or are not maintained with current data.
- *New information needs* - There may be new biodiversity-related topics requiring government policy making, or changes in policy aims and strategy, but suitable information is not yet easily available to support this decision-making.

Applying an information system approach

To help governments address these challenges, UNEP-WCMC has been developing an information system approach. An information system organizes how information for biodiversity policy is produced, analyzed and made available. There are a few essential components and linkages for an information system to operate (as defined in section 7.1). If some of the elements of such a system are not developed or do not function, then the whole system cannot provide the information needed.

The breadth of the information that a government could require for biodiversity policy is extensive. It includes data sets like animal abundance, location of protected areas and the status of ecosystem condition. Yet, there are many topics that may not seem to be related to biodiversity policy at first glance that actually are. These include information on the gender of decision-makers, the health benefits that people gain from ecosystems and the involvement of Indigenous Peoples in policymaking. All of these topics require some form of system to

provide the information that is needed. This system can provide indicators and reports and includes the operation of databases. The tools presented in this guide support the development of a whole information system, or the development of a database or an indicator as part of a system.

The development of indicators, analyses and information systems for biodiversity policy is not just a technical activity, as it requires the collaboration of different people and agencies over time. The tools are intended to be used with these collaborators in meetings and planning documents. They will help develop a shared understanding of what is required to have useful information, and to define organizational roles and activities as part of a system.

Section 3 of this guide presents suggested steps for projects to develop information products and systems for biodiversity policy. The use of relevant tools and templates is included in the steps.

How these materials were developed

These materials have been developed by UNEP-WCMC through a series of United Nations Environment Programme (UNEP) projects supported by the European Commission. They have been trialed and improved in workshops with staff from the Ministries of the Environment and NGOs (Non Governmental Organizations) from several countries

of eastern Europe, south-eastern Europe, southern Caucasus, and Central Asia. This guide, and the template tools, have been developed with the collaboration of the Ministry of Environment of Moldova, the Ministry of Environmental Protection and Natural Resources of Ukraine, and the Ukraine Nature Conservation Group.

2. TOOLS

A package of tools is provided here to help government agencies, NGOs and academics strengthen their information systems, indicators and databases to support biodiversity policy.



All of the materials are available at www.wcmc.io/info-systems-tool



2.1 Specification Templates

Three MS Word files are provided to serve as templates. One is a template for the specification of an information system, one is a template for an indicator and one is a template for a database. Figure 1 presents how the templates relate to the Biodiversity Information System Framework defined in Section 7.1.

The templates can be used to describe the current situation and then to describe the desired future situation. The template documents can be updated as progress is made for the subject.

The templates are illustrated with example information in Section 4.

Information System Specification Template - for a whole information subject and products

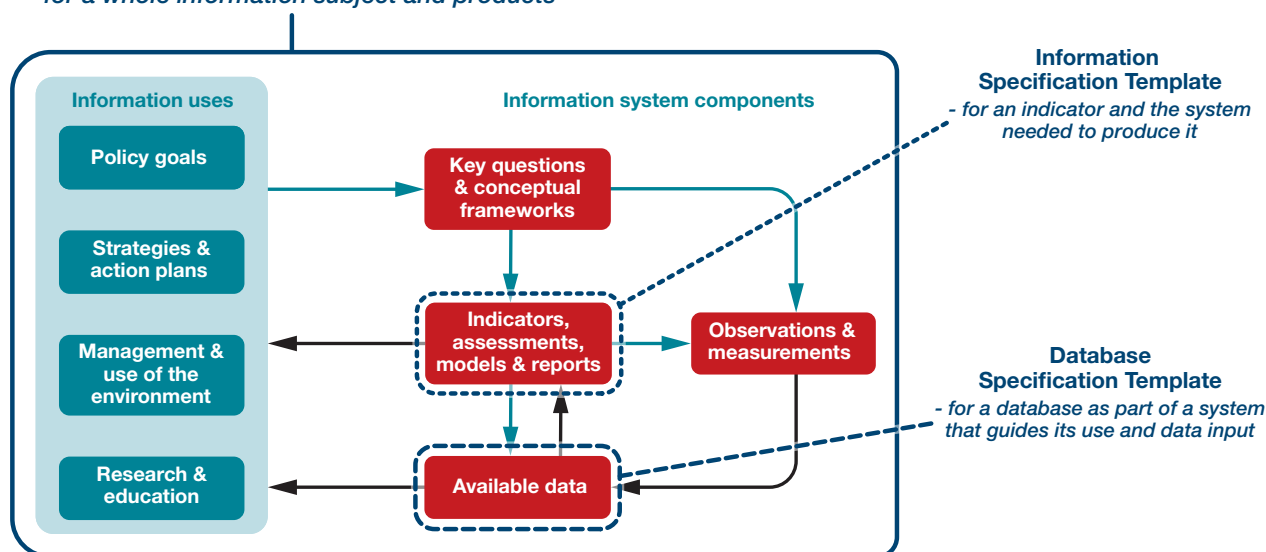


Figure 1. How the specification templates relate to the Biodiversity information System Framework.

Information System Specification Template

This template is used to specify and assess all the aspects of an information system for a given subject or user need. The template contains sections for each component of the information system and the agencies that are responsible for these.

Indicator Specification Template

This template is used to specify all the technical and institutional aspects for producing an indicator. The indicator template is similar to the information system template but has more sections for the definition of the indicator and its appropriate use.

Database Specification Template

This template is used to specify all the technical and institutional aspects that are required for the construction of a database. The template is built with the intention of the database content being appropriate for use in indicators and analyses.

2.2 Biodiversity information System Framework Tool

This tool is an interactive pdf file to describe and analyze for a subject all the components of an information system. These components are described in Section 7.1 and the tool is pictured below.

The tool provides a visual way to describe the adequacy of an information system's components, organization and data. For any question that policymakers have about biodiversity, they can use the diagram to assess if they have the indicators and data sets necessary to get answers. The diagram will

also reveal whose responsibility it is to provide information and if there are any gaps in the system. The tool produces a table of results and conclusions that can then be studied. This helps to rapidly identify the weak links and capacity development needs in the information system.

The tool is available in English, French, Spanish, Russian and Georgian. A guidance document with PowerPoint slides is available in English and Russian. A short video on how to use the tool is available in English.

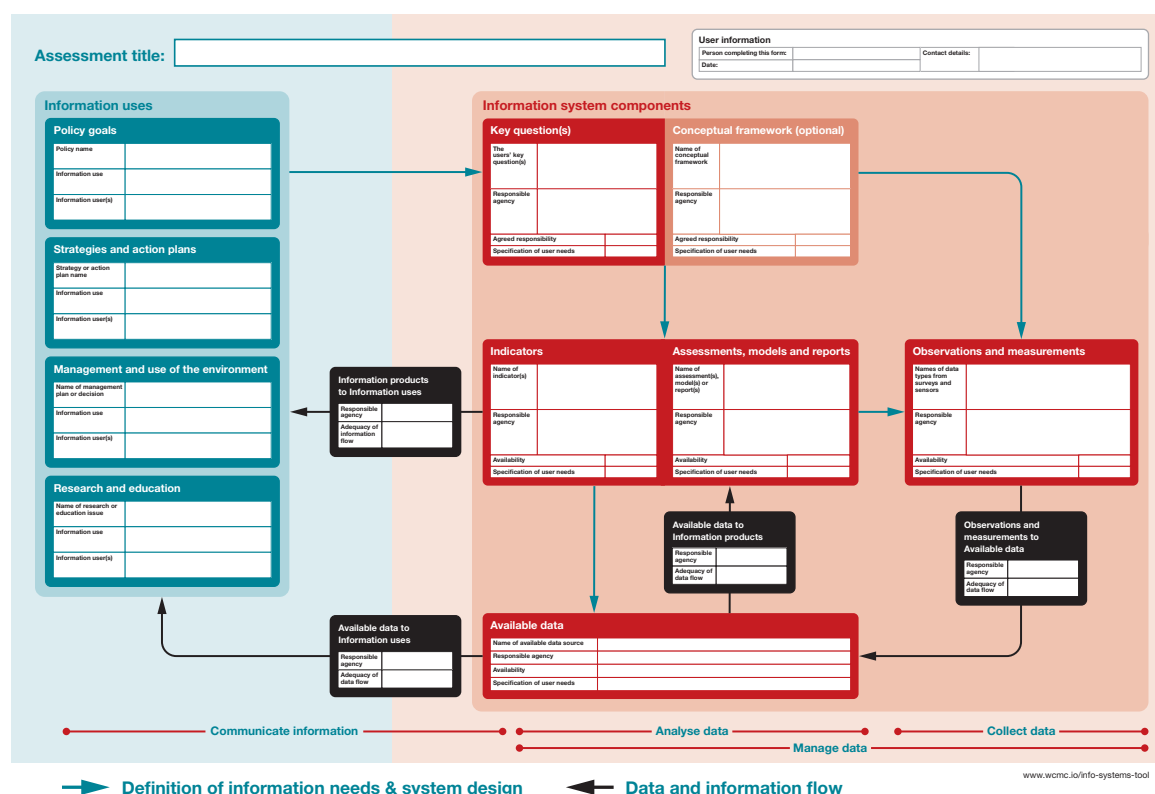


Figure 2. Image of the Biodiversity information System Framework Tool.

2.3 Capacity Development Assessment Tool

Capacity needs for an information system can include the development of skills, infrastructure, and institutional support. The Capacity Development Assessment Tool (CDAT), developed by UNEP-WCMC, helps determine the priority needs to strengthen capacity. The MS Excel tool is available at https://resources.unep-wcmc.org/products/WCMC_CB012

A fictitious example of how the tool can be used to assess capacity development needs for a government information system is available at www.wcmc.io/info-systems-tool. This example can be modified for use in an actual situation.

3. SUGGESTED STEPS FOR PROJECTS TO DEVELOP BIODIVERSITY INFORMATION PRODUCTS AND CAPACITY WITH A SYSTEM APPROACH

This section presents steps that are suggested for projects aimed at developing national capacity for biodiversity policy needs (Figure 3).

The steps should be seen only as suggestions. They are designed to assist planning and improve information availability. They work hand in hand with the other tools provided by this document.

The steps are presented on the assumption that a government agency is leading the development project and has the authority to act upon the results.

They are organized into six stages beginning with a stage that identifies a need for new or better information. The next stage establishes a project to address this need. The subsequent stages guide the user through planning and producing information products with the assistance of the tools.

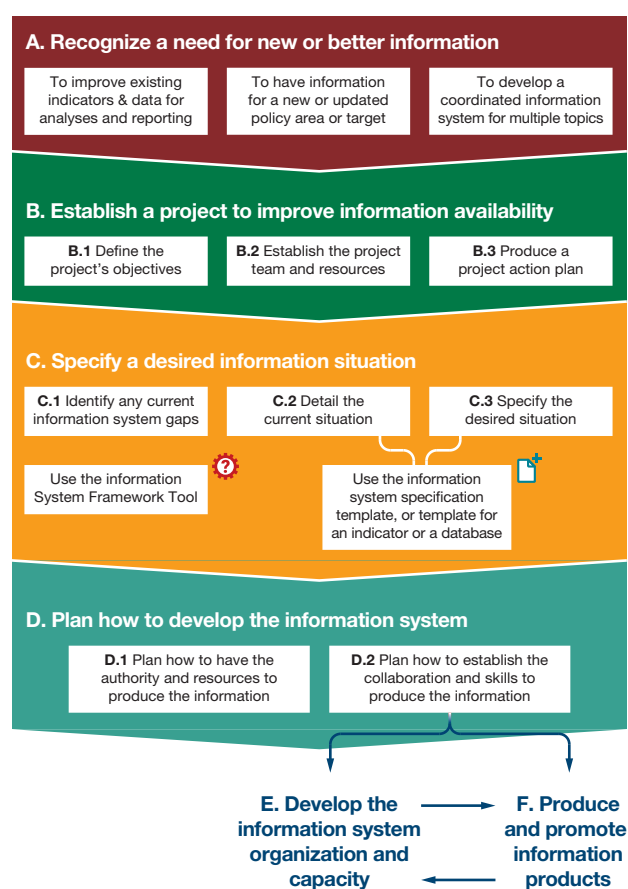


Figure 3. Suggested stages and steps to develop biodiversity information products and capacity with a system approach

Stage A. Recognize a need for new or better information

To improve existing indicators & data for analyses and reporting

To have information for a new or updated policy area or target

To develop a coordinated information system for multiple topics

Some common needs and starting places to develop biodiversity information for government include:

To improve existing indicators and data for analyses and reporting

Government decision-making or reporting is likely to already include the use of some indicators and analyses, but they often are not very specific or relevant. Accessible or suitable data sets are also frequently unavailable.

To have information for a new or updated policy subject or target

A need for new analyses and indicators may arise if a change of government results in the development of new policies. They may also be needed to meet new commitments created by international conventions and agreements. Policy may also be developed to help respond to an emerging problem in a country.

In some cases, an entirely new information system may have to be established. However, in some cases existing information capacity can be expanded.

To develop a coordinated information system for multiple biodiversity policy topics

The information system framework is highly flexible. It can support information systems at the national or sub-national scales. It can also support nested systems within those scales, as seen in Figure 4. The organization of such systems is likely to involve different government and non-government agencies.

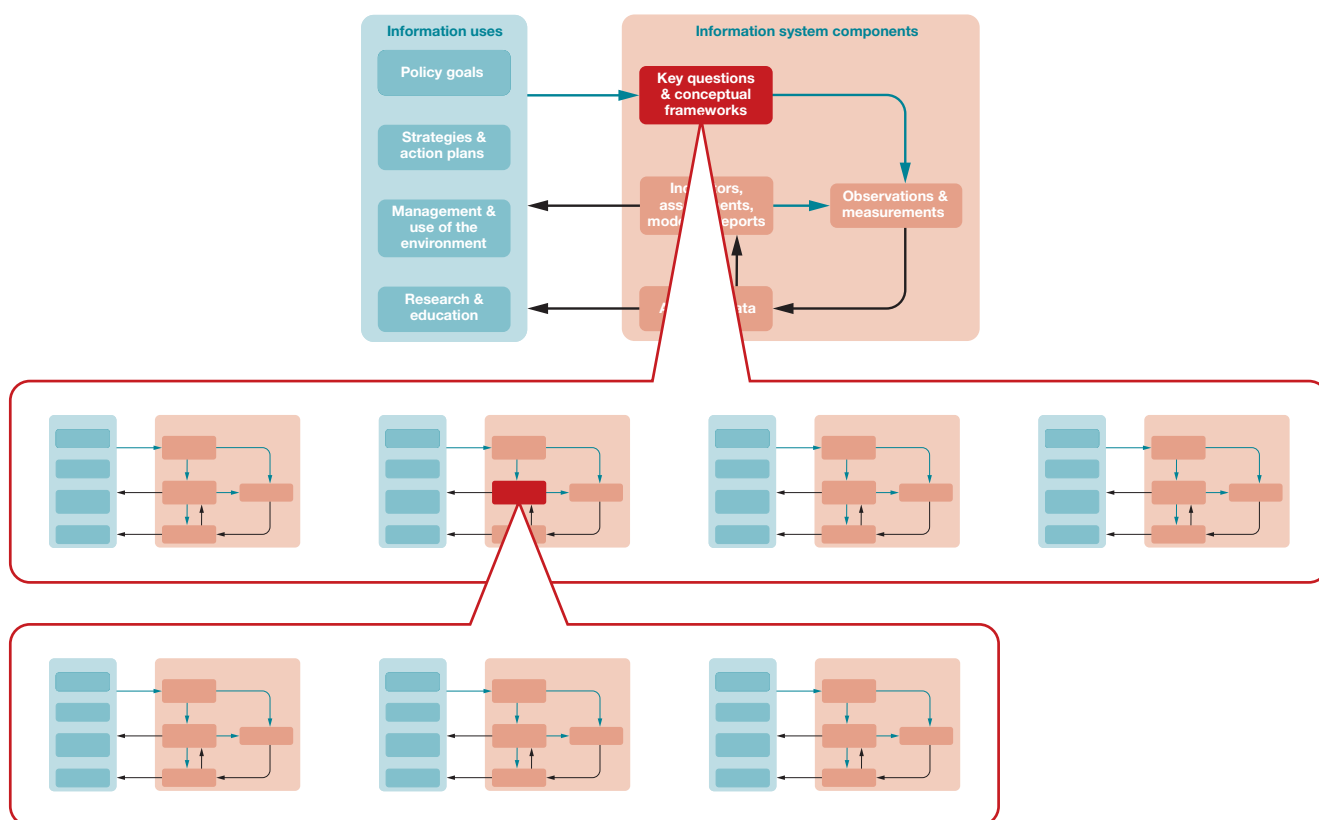


Figure 4. An illustration of how a national biodiversity information system could be organized as a nested set of systems to meet the information needs, or key questions, for multiple subjects, and for each of these subjects there will be several indicators which each require an information subsystem.

Stage B. Establish a project to improve information availability

B.1 Define the project's objectives

Stage B.1 Define the project's objectives

Define the scope and objectives of a project to improve information availability.

Examples of a project's scope could be:

- To provide new indicators and analyses.
- To strengthen the quality and availability of existing information products.
- To establish data collection and management systems for a defined information need or, if they already exist, improve them.

Specific results of the project and the timescale for the achievement of these results should be defined.

B.2 Establish the project team and resources

The project team should include expertise on the technical subject being addressed. It must also have team members with skills in data management, analysis and communication.

Obtain the resources needed for the project, including funding, office facilities and other equipment.

It may be necessary to establish a government mandate for the project to help ensure that:

- The results are recognized by the government.
- Relevant government agencies and civil organizations are motivated to participate in the project.
- More resources are available to support the project.

B.2 Establish the project team and resources

B.3 Produce a project action plan

Stage B.3 Produce a project action plan

To achieve the project's objectives (B.1), make an action plan to carry out the remaining stages presented in this guide. These stages are:

Stage C - Specify a desired information situation.

Stage D - Plan how to develop the information system.

Stage E - Develop the information system organization and capacity.

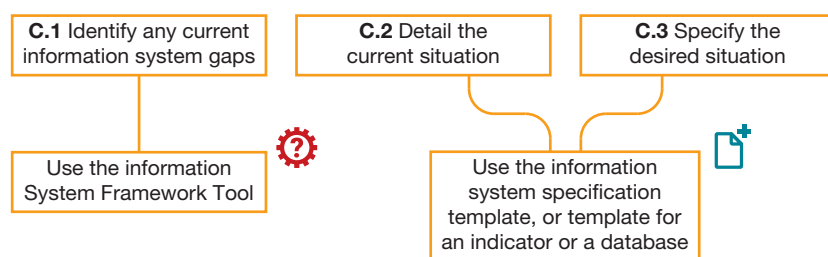
Stage F - Produce and promote information products.

The scope and details of the plan will be determined by the available team and resources (B.2). The project team should be familiar with the suggested stages C to F, and the specification templates for an information system, indicator or database. These templates will guide and record the definition of current knowledge and results.

The plan produced at Stage B will be revised and further detailed in Stage D.

A very important part of the project plan is to define how to involve the relevant information users, analysts, data managers and data providers. Adequate consultation and communication with these stakeholders will promote their ownership and support for the information products and system.

Stage C. Specify a desired information situation



Stage C.1 Identify any current information system gaps

If the scope of the project is to improve existing information for a subject, users could make use of the *Information System Framework Tool*. This will help to identify any gaps and priorities for action to strengthen the system. The tool will also help the project team and other stakeholders to quickly learn the information system approach as a guide for their work.

Stage C.2 Detail the current situation

Unless the information subject is a new one without any current capacity, use the relevant specification template to produce a detailed description of the current situation:

- Overall information system specification template.
- Indicator specification template.
- Database specification template.

It is likely that there will be sections of the template that cannot be completed yet, but this enables the identification of any gaps in the system.

For the definition of indicators, it is important to design them to respond to the key questions created by policymakers and others. This may not require the development of new indicators, as many regional and global policy processes have developed indicator frameworks to support their implementation and reporting.

Stage C.3 Specify the desired situation

Use the specification templates to define the situation that is desired in the future. If the current situation has been defined in Stage C.2, it can be adapted to have a definition of the desired situation.

Stage D. Plan how to develop the information system

D.1 Plan how to have the authority and resources to produce the information

D.2 Plan how to establish the collaboration and skills to produce the information

Stage D.1 Plan how to have the authority and resources to produce the information

Use the results of Stage C to revise the action plan from Stage B to:

- Make sure the lead agency for the information system, indicator or database has the required authority for this role.
- Ensure that funds to produce and maintain the information products over time are available.

Stage D.2 Plan how to have the collaboration and skills to produce the information

Stage C may identify gaps in the institutional collaborations or skills to produce the information. If this is the case, these requirements can be addressed in the action plan.

Actions for skills development can also be included in the last section of the information system specification templates. The Capacity Development Assessment Tool (CDAT) can be used for a more comprehensive needs assessment and to prioritize actions.

Stage E. Develop the information system organization and capacity → Stage F. Produce and promote information products

These two stages are presented together because it is best to develop the information system organization through 'learning by doing'.

Stage E is the implementation of the plan developed in Stage D. Once the coordinated roles and skills of the key players in the system are established, the production of information products in Stage F can proceed.

Stage F involves the production of information products and promotes them. When users see the benefits of the information provided, this raised awareness that can be capitalized upon and used to build understanding and support for the systems that produce the information.

As information products are developed, the lessons learned from this experience can improve future system specifications and development plans.

4. SPECIFICATION TEMPLATE EXAMPLES

This section presents the structure of the three specification templates.

The template for a whole information system is illustrated with content from the UNEP project developed with the Ministry of Environmental Protection and Natural Resources of Ukraine, and the Ukraine Nature Conservation Group.

The indicator specification template is illustrated with a fictitious example.

The database specification template is illustrated with content developed with the Ministry of Environment of Moldova.

The MS Word templates can be accessed at www.wcmc.io/info-systems-tool

Template – Information system specification

1. Subject of the Information System

Alien Species (AS) in Ukraine

2. The responsible agency and person for the organisation of the overall information system to provide answers to the user's key questions

Ministry of Environmental Protection and Natural Resources of Ukraine, but with scientific analytical work done by the National Academy of Sciences, and technical support of specialists from other Ministries /State Agencies (Forestry, Fishery, Food Safety etc.)

Ministry of Environmental Protection and Natural Resources of Ukraine

<https://mepr.gov.ua/>

National Academy of Sciences:

Institute of zoology

<https://www.izan.kiev.ua/>

Institute of botany

<https://www.botany.kiev.ua/>

Institute of Marine Biology

<http://www.imb.odessa.ua/?id=20>

State Forest Resources Agency of Ukraine

<https://forest.gov.ua/en>

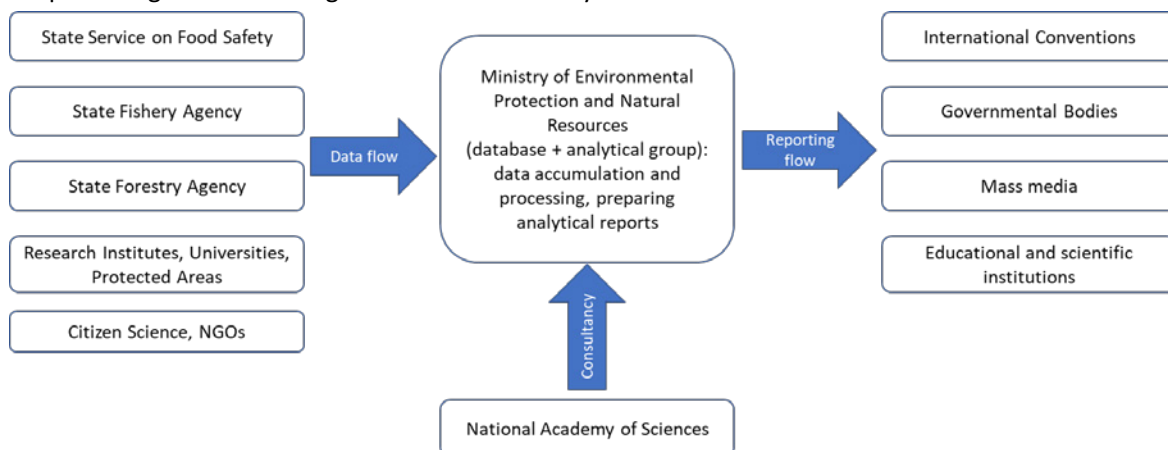
State Melioration and Fishery Agency of Ukraine

https://darg.gov.ua/poshuk_po_sajtu_0_1050_menu_0_1.html

State Service of Ukraine on Food Safety and Consumer Protection (SSUFSCP)

<https://dpss.gov.ua/en>

Proposed organizational diagram for information system on AS in Ukraine:



Information System Specification

Brief description of the role of key stakeholders:**1) Ministry of Environmental Protection and Natural Resources**

Leading state executive body in the field of conservation of environment. The Ministry will be responsible for:

- development (or initiation of) an appropriate legal, institutional and financial framework for the AS information system framework.
- coordination and support for the AS information system (incl. AS Database).

2) State Service on Food Safety and Consumer protection

This State Service is responsible for phytosanitary control at the border as well as within the country. They completely concentrate on the species on the List of regulated harmful organisms. A large proportion of the species on this list are AS. This information State Service will provide data to the future AS database.

3) State Forest Resources Agency

The activity of this Agency is related to alien species in several ways. First, they should control spreading of IAS in forests. Second, they are responsible for control of forest pests and diseases (including species from the List of regulated harmful organisms). Third, they use alien plant species in forestry, and study the possibility to use new alien species which are resistant to climate change. Fourth, this agency also controls hunting in the country, but among the hunted species there are about 10 alien species, and half of them are AS. Some hunters of alien species breed these species and support their release in hunting grounds. Therefore, the Forest Agency can provide information on: 1) AS which are present in state forests (distribution, spreading etc.); 2) Alien species which they use in forestry; 3) Alien animal species used in hunting (in nature and in enclosure farms).

4) State Melioration and Fishery Agency

The Fishery Agency is linked with alien species in several ways. First, they should control (at least collect information) on the use of alien species in aquaculture, a big part of which is based on alien species. Second, the agency also controls the release of some alien fish species into waterbodies (rivers, reservoirs etc.), which is still quite a common practice. Thus, the Fishery Agency can provide information on: 1) Alien species used in aquaculture; 2) Alien fish species released into nature.

5) Research Institutes, Universities, Protected Areas

All of these types of organizations conduct different scientific studies or monitoring works. Study of AS is not a key direction for them, but each year they collect some information which is published in scientific papers. Strengthening research in this direction can give much more information on AS.

6) Citizen Science, NGOs

Citizen Science and NGOs in principle can provide quite a lot of records of AS, especially species that are easy to identify. The most suitable way to do it is through different smartphone applications, like [Inaturalist](#).

7) Other stakeholders

This group is not included in the diagram above, but some additional stakeholders would also be useful for collecting information on AS. First of all these are local and regional authorities, which according to legislation should control AS within the settlements, especially species dangerous for people health. But in fact they do not work in this direction.

Information System Specification

3. Users of the information

Ministry of Environmental Protection and Natural Resources of Ukraine, State Service of Ukraine on Food Safety and Consumer Protection, State Service of Ukraine on Food Safety and Consumer Protection, State Forest Resources Agency of Ukraine

Policy and decision makers at different levels (Cabinet of Ministers, Parliament (Verkhovna Rada of Ukraine), State administrations at oblast, district and city levels etc.)

Scientific institutions

Educational institutions (universities, schools)

NGO and general public

4. Uses of the information (including for decision-making and reports)

Regular updating of the list of alien species (AS)

Prediction of the emergence of new AS from adjacent countries

National assessment of the distribution and spread of AS.

National assessment of the impact of AS.

Development and updating the National Biosafety and Biological Protection Strategy and Action Plan.

National State of the Environment report

National reports to CBD and other relevant international agreements

Informing politicians, decision makers at different levels on the status and impacts of AS and the measures for their management

Support of scientific research on AS (exchange of information, research planning etc.)

Education and training on IAS as well as development of public monitoring (citizen science)

Raising awareness of politicians, decision makers and general public on the existence of IAS and their impacts.

**5. Information User's Key Question(s)**

What is the definition of alien species (AS) and invasive alien species (IAS)?

What is the scale of the problem of AS at global and national level?

What is the current list of AS and IAS?

What is the distribution of AS?

What is the abundance (current and trends) of AS?

What are the characteristics of AS?

What are the impacts of AS on nature and natural ecosystems?

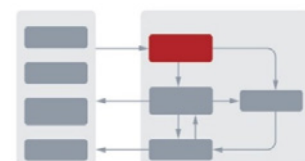
What are the impacts of AS on the economy?

What are the impacts of AS on human health?

What are possible new AS in UA?

What are the management / control measures for AS?

What are the results of management / control measures for AS?

**6. Government laws and/or policies which makes a commitment for information to be available for this subject**

Prevention of the spread of IAS and control over the introduction of such species into natural ecosystems, including marine ecosystems, is one of the tasks of the **Key Principles (Strategy) of the state**

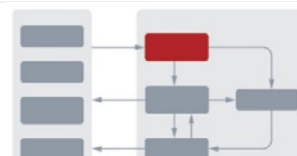
Information System Specification

environmental policy of Ukraine for the period till 2030, approved by the Law of Ukraine of February 28, 2019 No. 2697-VIII (<https://zakon.rada.gov.ua/laws/show/en/2697-19#Text>)

The **Strategy of biosafety and biological protection**, approved on 12/17/2021, covers a wide range of biological security issues, including the issue of alien species (<https://zakon.rada.gov.ua/laws/show/668/2021#Text>), and an inventory and monitoring of the state of populations of invasive alien species, and a development of a public information system.

7. Conceptual framework of the subjects addressed in the key question(s) (optional)

(include a diagram with text to interpret the logic of the diagram, and who produced the diagram)



8. Indicators and maps to help answer the key questions

Indicators:

a) species number and distribution

- Number of AS and IAS in UA and in each administrative region of the country.
- Area of country affected by IAS.
- Rate of increase in the area of distribution of IAS (per species and cumulative).
- Rate of appearance of new IAS for the last 5 or 10 years.
- Abundance of IAS, and rate of change in IAS abundance (per species and cumulative).
- Number of new IAS expected in next 3-5 years in UA from adjacent regions.

b) influence on rare species, natural ecosystems and ecosystem services

c) policy and management

Progress in the implementation of the National Biosafety and Biological Protection Strategy) and the National Biodiversity Strategy and Action Plan:

- Number and percentage of items completed in accordance with the plan.
- Legislative improvements (number of new documents).
- Number of management or control actions in relation to IAS on the ground.

d) economy

- Economic damage from IAS in current year (or certain period).
- Cost of management or control actions in relation to IAS on the ground in current year (period).

e) human health

- Number of people whose health is affected by IAS (by administrative regions and in total).

Maps:

- Distribution of AS/IAS – single species maps [two layers: 10x10 km+ administrative units].
- Distribution of AS/IAS – generalized map [two layers: 10x10 km+ administrative units].

The desired frequency of production of the indicators and maps will depend on national and international reporting needs, from annual up to 3-5 years period. With a fully organized database and GIS the frequency can be a short time.

The responsible agency and person for producing the indicators and communicating them to users

Ministry of Environmental Protection and Natural Resources

Information System Specification

9. Reports and their frequency to help answer the key questions

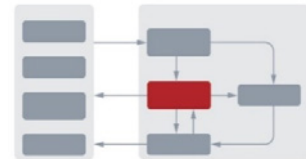
Depending on national and international reporting needs. From annual up to 3-5 years period:

- Annual report on National Biosafety and Biological Protection Strategy.
- Annual national report on the status of environment.
- Reports to conventions – CBD, Bonn etc.

Information is also needed on the criteria and classification of AS and IAS, references to key documents (legislation, plans, manuals) and sources of information (links, publications) etc.

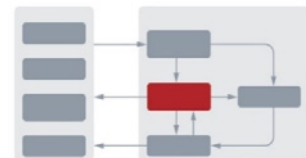
The responsible agency and person for producing the reports and communicating them to users

Ministry of Environmental Protection and Natural Resources

**10. Assessments and/or models** that use the indicators and other information to help answer the key questions (*optional*)

The responsible agency and person for producing the assessments and/or models

Frequency of production of the assessments and/or models

**11. Database title:**

Alien species database of UA

Responsible agency and person:

Ministry of Environmental Protection, but with scientific analytical work done by the National Academy of Sciences, and specialist services of other Ministries / State Agencies (Forestry, Fishery, Food Safety etc.)

Website of available data – location, responsible agency and person

Ministry of Environmental Protection and Natural Resources

**12. Specification of observations and measurements** required for the indicators and analyses to answer the key questions

Registrations of AS - coordinates, data, abundance, method of data collecting, source of information etc.

Sources of observations and measurements for the database, including the responsible agency and person for carrying out the observations and measurements

- targeted field studies conducted by scientists.
- scientific publications.
- data from different state agencies (forestry, fishery, service on food safety and consumer protection).
- appropriate websites (birdwatchers, hunters, anglers etc.) and from citizen science.



Information System Specification

13. Costs to operate the information system

Annual staff and office costs (current and future years) + source of funding

Source of funding – state budget

Annual computing and other infrastructure costs (current and future years) + source of funding

Not possible to calculate at this stage

Annual costs to produce information products (indicators, reports, etc.) (current and future years) + source of funding

Not possible to calculate at this stage

14. Capacity development needs

Personnel or staff positions to be filled

Minimum of 5 persons to support the database and to produce the technical reports from the database.

Technical skills to be developed (including data collection, management, analysis, and information communication)

Not possible to determine at this stage

Computing and other infrastructure needs to be developed

Not possible to determine at this stage

Template – Indicator specification

Indicator Specification Template

1. Indicator name

Protected Natural Areas coverage of country X

2. The responsible agency and person for the production and communication of the indicator

Ministry of Environment – Protected Areas Agency

3. Users of the indicator

Ministry of Environment - Biodiversity Policy Division

Ministry of Environment – Protected Areas Agency

Environmental Protection Agency

Ministry of Agriculture and Forestry

National Statistics Office, Chief Statistician

Environmental NGOs

4. Uses of the indicator

Policy development and implementation on biodiversity and protected areas, including:

- Protected Areas Strategy 2020-2025.
- Environment Strategy 2023- 2028.
- National Biodiversity Strategy and Action Plan (NBSAP) 2024 – 2030, including Target 3. Increasing the extension of state protected natural areas to up to 20% of the surface areas of the country and develop 24 management plans for protected areas.

Strategic planning on biodiversity and forestry.

To inform land use decision-making, including biodiversity and Protected Areas.

Reporting on country X's protected areas and relevant targets to Parliament, Convention on Biological Diversity, and World Database on Protected Areas (www.protectedplanet.net)

Annual government statistical reports and reporting on Sustainable Development Goals.

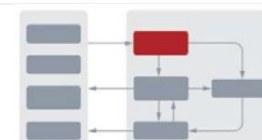
National State of the Environment report – every 5 years.



5. Information User's Key Question(s) that the indicator helps to answer

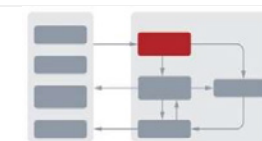
What is the coverage and location of natural protected areas?

Are we reaching our NBSAP target for protected areas?



6. Conceptual framework of the subjects addressed in the key question(s) (optional)

(include a diagram with text to interpret the logic of the diagram, and who produced the diagram)

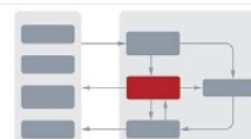


Indicator Specification Template

7. Definition of the indicator

Amount and percentage of protected areas coverage of the country and of each ecosystem type, per year and by IUCN management category.

Map of locations of protected areas, coded by IUCN management category.



8. Units of the indicator (e.g. km², number of individuals, % change)

Extent of protected areas in km² in total and by IUCN management category and ecosystem type.

Percentage coverage of the national territory by protected areas, and by IUCN management category and ecosystem type.

9. Forms of presentation (graph types, maps, narrative text, etc. – give examples where possible)

Bar charts of protected area extent and percentage of national coverage by year, and by IUCN management category and ecosystem type.

Maps of latest data on protected area location, by IUCN management category.

Summary tables of data on protected area extent and coverage, by IUCN management category and ecosystem type.

10. Calculation procedure

Spatial analysis of protected area site data in a GIS with layers of ecosystem extent.

11. Frequency of production of the indicator

Annual.

12. Where the indicator results are published

Annual report and website of the Protected Areas Agency.

Website of the National Statistics Office.

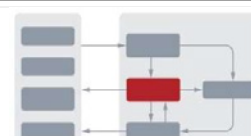
13. Reports and their frequency that use the indicator

Annual report of the Protected Areas Agency.

State of the Environment Report – every five years.

Report on national implementation of the Convention on Biological Diversity – every three or four years.

Annual report on Sustainable Development Goals of the National Statistics Office.



The responsible agency and person for producing the reports

Protected Areas Agency

14. Assessments and/or models that use the indicator and other information to help answer the key question(s) (optional)

The responsible agency and person for producing the assessments and/or models

Frequency of production of the assessments and/or models



Indicator Specification Template

15. Data source for the indicator (e.g. a database)

National database on protected areas

Responsible agency and person for the data source

Protected Areas Agency

Time period for which data is available

1980 to 2022

Level of coverage by the data for the subject of interest (e.g. geographical area, relevant populations)

Complete national coverage of protected areas by national classification and IUCN management category.

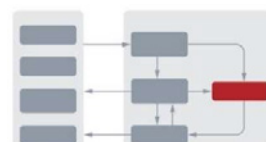


16. Observations and measurements required for the indicator

Natural protected area name, location, designation type, boundary co-ordinates, area (extent), management authority, date of establishment, IUCN management category.

Primary providers or source of observations and measurements for the indicator

Protected Areas Agency



17. Development status of the indicator (e.g. proposed, in draft form, fully specified and adopted)

Fully specified and adopted.

18. Considerations for interpretation of the indicator results (e.g. how effectively it helps to answer the key question; limitations of the data; its suitability for aggregation; meaning of upward or downward trends; threshold values)

The indicator is a direct measure of the key question and is straightforward for the user to interpret the results without additional information or explanation. The available data have sufficient coverage of the protected areas system for measurement of protected areas coverage of the country and ecosystems.

19. Limits to the indicator's usefulness and accuracy (e.g. slow change in response to changes in the subject of interest; poor quality data; limited scope for updating)

None.

20. Closely related indicators (including in national and international processes)

Proposed national indicator on management effectiveness of protected areas.

Global Biodiversity Framework Headline indicator 3.1 Coverage of protected areas and OECMs

SDG Indicator 15.1.2: Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type.

21. Costs to produce and maintain the indicator

Annual staff and office costs (current and future years) + source of funding

Annual computing and other infrastructure costs (current and future years) + source of funding

Indicator Specification Template

Annual costs to produce information products (indicators, reports, etc.) (current and future years) + source of funding
22. Capacity development needs Personnel or staff positions to be filled Technical skills to be developed Computing and other infrastructure needs to be developed
23. Further information sources and details

Template – Database specification

1. Database name

Database of Natural Protected Areas of Moldova

2. The responsible agency and person for the operation of the database and delivery of its data to users

Lead Agency:

Environmental Protection Agency - <https://am.gov.md/>, Natural Resources Monitoring Department, and Integrated Environmental Information Management Department

Other providers of data:

Moldsilva Agency - <https://www.moldsilva.gov.md/?l=en>

Ministry of Environment – Biodiversity Policy division - <https://www.mediu.gov.md/>

P.I. Institute for Forest management (ICAS) - <https://icas.com.md/>

Scientific reserves: Codrii, Plaiul Fagului, Padurea Domneasca, Prutul de Jos (Biosphere reserve),

National parks: Orhei, Nistru de Jos

Institute of Ecology and Geography - <https://ieg.md/>

State Enterprise Institute of Geodesy, Technical Surveying and Cadastre – INGEOCAD - <https://www.ingeocad.md/index.php/ro/>

National Geospatial Data Fund –

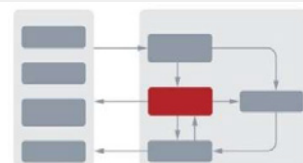
<http://geoportal.md/ro/default/map#lat=251915.663697&lon=188651.484371&zoom=0>

3. Information products using data from the database

Indicators and **maps** that require data from the database + responsible agency for the indicator

Amount and percentage of protected areas coverage of the country and of each ecosystem type, per year and by IUCN management category and in the Emerald Network or not.

Map of locations of protected areas, coded by IUCN management category and the Emerald Network.



Responsible agency for the indicators and maps

Environmental Protection Agency- Natural Resources Monitoring Department and Integrated Environmental Information Management Department

P.I. Institute for Forest management (ICAS) - <https://icas.com.md/>

Institute of Ecology and Geography - <https://ieg.md/>

State Enterprise Institute of Geodesy, Technical Surveying and Cadastre – INGEOCAD - <https://www.ingeocad.md/index.php/ro/>

National Geospatial Data Fund –

<http://geoportal.md/ro/default/map#lat=251915.663697&lon=188651.484371&zoom=0>

Reports that use indicators or other analyses from data in the database

Annual report on Moldova's protected areas system and progress to NBSAP targets to Parliament, the CBD, Bern Convention.

Annual government statistical reports

National State of the Environment report – every 5 years, 2022.

Database specification

Responsible agency for the reports

Environmental Protection Agency- Natural Resources Monitoring Department or Integrated Environmental Information Management Department

Moldsilva Agency - <https://www.moldsilva.gov.md/?l=en>

Ministry of Environment – Biodiversity Policy division - <https://www.mediu.gov.md/>

P.I. Institute for Forest management (ICAS) - <https://icas.com.md/>

Scientific reserves: Codrii, Plaiul Fagului, Padurea Domneasca, Prutul de Jos (Biosphere reserve)

National parks: Orhei, Nistru de Jos

Institute of Ecology and Geography - <https://ieg.md/>

Models and assessments that use data from the database

-

Responsible agency for the models or assessments

-

4. Additional users and uses of data from the database

Moldsilva Forestry Agency, for designation, management and reporting of protected natural areas under their responsibility.

Ministry of Environment – Biodiversity Policy division - <https://www.mediu.gov.md/>,

P.I. Institute for Forest management (ICAS) - <https://icas.com.md/>,

Scientific reserves: Codrii, Plaiul Fagului, Padurea Domneasca, Prutul de Jos (Biosphere reserve)

National parks: Orhei, Nistru de Jos,

Institute of Ecology and Geography - <https://ieg.md/>

State Enterprise Institute of Geodesy, Technical Surveying and Cadastre – INGEOCAD - <https://www.ingeocad.md/index.php/ro/>

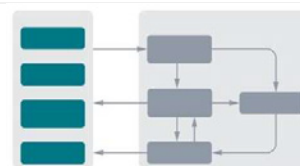
National Geospatial Data Fund –

<http://geoportal.md/ro/default/map#lat=251915.663697&lon=188651.484371&zoom=0>

Local Public Authorities responsible for management of some natural protected areas, and for land use decisions and enforcement.

Institute of Ecology and Geography, for research and management of natural protected areas.

Environmental NGOs supporting the creation and management of natural protected areas. – BIOTICA Ecological society, Eco-Contact NGO, Ecological Movement NGO, EcoTIRAS NGO, Forestry Women etc.

**5. Information User's Key Question(s) for which the database provides data to help to answer the questions**

What is the coverage and location of natural protected areas?

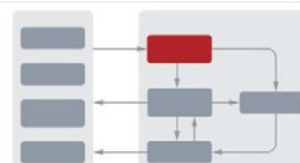
Are we reaching our NBSAP target for protected areas?

Where are the protected natural areas in Moldova?

Is Moldova's protected area system covering all the ecosystems and important areas for biodiversity in the country?

Is the protected area part of an Emerald site?

What is the proportion of Protected areas in the Emerald Network?



Database specification

Do Protected Areas have developed management plans?

Do the existing Protected Areas ensure sufficiency for Emerald species and habitats?

Does the existing system of protected areas ensure in-situ conservation, including of Red Book species?

6. Data in the database

Data fields or attributes in the database

Record unique identifier

Name of the protected area

Designation(s) in national legislation

IUCN management category

Area (square kilometres)

Status (proposed, designated, dedesignated)

Year of designation

Governance type (national government, local government, private, non-governmental organization)

Ownership (state, individual landowners, for-profit organizations, non-profit organizations, joint ownership, contested)

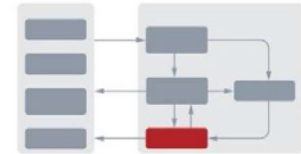
Management authority

Management plan (link or reference to the protected area's management plan)

Management objectives

Supporting information

Spatial data (polygon data on the protected area's boundaries and any management zones)



Time period for which data is available

State of Environment in the Republic of Moldova -2003

2007-2010

2015-2018

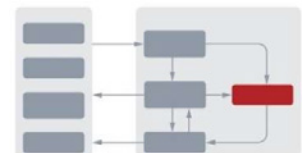
Level of coverage by the data of the subject of interest (e.g. geographical area, relevant populations)

Natural protected areas designated by Local Public Administrations are not yet included in the database.

Some information on the boundaries of natural protected areas managed by Moldsilva needs to be updated.

7. Observations and measurements required for the database fields

The same data for each natural protected area as specified in section 6 for the database fields.



Primary providers or source of observations and measurements for the data in the database

Moldsilva Forestry Agency

P.I. Institute for Forest management (ICAS) - <https://icas.com.md/>

Scientific reserves: Codrii, Plaiul Fagului, Padurea Domneasca, Prutul de Jos (Biosphere reserve)

National parks: Orhei, Nistru de Jos

Institute of Ecology and Geography - <https://ieg.md/>

Botanical Garden (Institute) Al.Ciubotaru - <https://gbni.usm.md/>

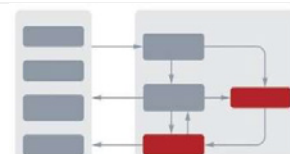
Institute of Zoology - <https://zoology.md/institutul-de-zoologie>

Local Public Administrations (to be identified)

Database specification

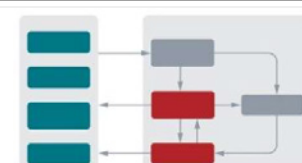
8. How and when the data in the database is obtained from primary providers of the data (observations and measurements)

The Environmental Protection Agency- Natural Resources Monitoring Department or Integrated Environmental Information Management Department – has established a Data Provider Agreement with Moldsilva for the submission in January each year of updated data on the natural protected agencies under the management of Moldsilva. The EPA verifies with Moldsilva that the submitted data has been correctly included in the national database on protected natural areas. The EPA is working to establish Data Provider Agreements with the relevant Local Public Administrations.

**9. How and when the data in the database is made available to users** (including terms of use and licences on use)

The data is available in Excel and GIS form to the Ministry of Environment, Moldsilva, Local Public Administrations and other government agencies, including the Institute of Ecology and Geography, and NGOs, on request.

A website for public viewing and download of the data and summary indicators and maps will be developed.

**10. Development status of the database** (e.g. proposed, in pilot form, fully operational)

In 2022 the database is in pilot form and will be fully operational with a website for viewing and accessing the data in 2023.

11. Closely related databases (including in national and international processes)

The database is linked to the World Database on Protected Areas, and the data is submitted annually to the European Environment Agency.

12. Costs to operate the database

Annual staff and office costs (current and future years) + source of funding

Annual computing and other infrastructure costs (current and future years) + source of funding

Annual costs to produce information products (indicators, reports, etc.) (current and future years) + source of funding

13. Capacity development needs

Personnel or staff positions to be filled

Technical skills to be developed

Computing and other infrastructure needs to be developed

14. Further information sources and details

5. CASE STUDY OF INFORMATION SYSTEM DEVELOPMENT

This section summarizes the steps and some lessons from the initial development of an information system on invasive alien species (IAS) in Ukraine. This experience is from 2021 to 2023,

when UNEP-WCMC provided technical assistance to the Ministry of Environmental Protection and Natural Resources (MEPNR) of Ukraine under a UNEP project supported by the European Commission.

Organization of the information system development as a project

In 2021 the Government of Ukraine approved its first Strategy of Biosafety and Biological Protection. The Strategy includes establishing a system to control introductions of invasive alien species (IAS), removals of harmful IAS, and carrying out inventories and monitoring of the state of IAS and their impacts. The Ministry of Environmental Protection and Natural Resources (MEPR), through its Department of Bioresources and Biosafety, is the lead agency for the development of a new IAS information system.

information system was conducted with the National Academy of Science and the NGO Ukrainian Nature Conservation Group, who provided expertise on the subject of IAS, access to suitable data, and expertise in the collection and analysis of scientific data. The Ministry organized collaboration of the project with other key state stakeholders, and played a key role in the analysis of policy and legislation, and in the information system design, with the steps summarized below.

The first stage of the UNEP project to develop the

Initial results in the development of an alien species (AS) information system for Ukraine.

Please note that the development of Ukraine's AS information system is ongoing and only preliminary and summary results for 2023 are presented here. The initial work addressed the two key questions:

"What is the outline of an information system in term of organizational structure, key stakeholders, indicators etc.?" and "What is the check list and distribution of alien species?"

Key questions on the impacts and management of IAS will be addressed once further information and management capacity has been developed for these subjects.

In Ukraine there are no state information systems on biodiversity which could be used as a basis for creating an information system on alien species, but the development of such systems will be addressed in the upcoming revision of the National Biodiversity Strategy and Action Plan as well as a future national biodiversity database.

Information System Development Step	Activity and result
1. Identification of information uses and the key questions of the information users.	The use, or purpose, of the information system was defined as - to support development and implementation of an IAS control strategy by the Ministry of Environmental Protection and Natural Resources, including its working group on biosafety. Key questions to be addressed by an information system: • What is the checklist, spatial distribution and abundance (current and trends) of alien species? • What are the impacts of alien species (AS) on nature and natural ecosystems? • What are the impacts of alien species on the economy and on people's health? • What are the results of management and control measures for alien species? The scope of the information system is to include all alien species, as it is not possible to always distinguish which species will become invasive and a problem.
2. Definition of information products.	For the project a report was produced on the current state of knowledge of the abundance and distribution of IAS in Ukraine. Currently in Ukraine there is not an official national list of alien species or even invasive species only. In 2023 the Ministry of Environmental Protection and Natural Resources of Ukraine has initiated a development of a list of the most dangerous IAS plants and animals. Among information products of the current projects were the following: 1) List of Ukraine alien vascular plants; 2) Updated list of Ukraine alien animal species, prepared by Institute of Zoology National Academy of Science Ukraine in 2018; 3) Prepared drafts of the lists of TOP-20 IAS for plants; 4) Prepared distribution maps for the most dangerous IAS (presence-absence per administrative oblast); 5) Collection of 103 scientific papers (507 pages) on alien species records in Ukraine, published in pdf format; 6) Create an initial data base of alien species records in Excel format, which includes 8,239 records. These data was already submitted to Global Biodiversity Information Facility (GBIF). A report will be produced to support decision-making by the Ministry of Environmental Protection on the 'top twenty' alien plant and animal species requiring action to reduce their impacts, as part of a National Biosafety and Biological Protection Strategy. This information will also be used to support development of the National Biodiversity Strategy and reporting to the CBD, and harmonization of policy with the European Union. Decision made to develop indicators on: • Number of alien species and invasive alien species (IAS) in Ukraine and in each administrative region (oblast, district) • Area of the country affected by IAS • The rate of increase in the area of distribution of IAS (by species and cumulatively) • The rate of emergence of new IAS over the past 5-10 years • The number of IAS and the rate of change their number (by species and cumulatively) • The number of new IAS expected within the next 3-5 years in Ukraine from neighboring countries Resources are currently only available to start development of the the set of the most simple indicators. The more "difficult" indicators like impact on biodiversity, economy etc. should be developed and implemented later, when an information system will be fully operational with regards to collecting of basic information. Maps of Distribution of AS and IAS – single species maps and a generalized map. The frequency of calculation of the indicators and preparation of corresponding maps is yet to be determined, considering the needs of national and international reports, ranging from annual to 3-5 year periods. This definition is needed to be able to define the scope and organization of an information system, with responsible agencies and long-term funding.

Information System Development Step	Activity and result
3. Definition of how data is made available.	A first stage was to compile an MS Excel database of alien species records, including their distribution and abundance in Ukraine. This data collected within the project was submitted to the Global Biodiversity Information Facility (GBIF), so that is accessible online within Ukraine and internationally. In the future it will be very important to combine the database with some kind of geospatial-information system (ArcMap etc.). Final decision on the software for the database and detailed definition of the structure of a database on alien species can only be determined by the needs of the indicators that will be expected from the information system.
4. Definition of the type and form of observations and measurements required.	For the first stage of the development of the information system the following types of information on alien species are proposed - coordinates, abundance, method of data collection, source of information etc.
5. Collection of data on observations and measurements	The main sources of the data for planned information system will be the following: ● reports of targeted field studies conducted by scientists and NGOs ● data from different state agencies (forestry, fishery, service on food safety and consumer protection) ● relevant websites of interest groups (birdwatchers, hunters, anglers etc.) which record species (citizen science, including iNaturalist). The first step towards establishing of data set on alien species for the information system was done in the frame of current project, which compiled 103 scientific papers (507 pages) concerning alien species and published the book "Records of alien plant and animal species in Ukraine" (https://uncg.org.ua/wp-content/uploads/2023/06/2_Chuzhoridni_20.06_compressed.pdf). This activity with the scientific community stimulated their engagement in the subject, and resulted in about 8,239 records of alien species of fungi, plants and animals. The Ministry of Environmental Protection requested submission of relevant alien species records from the National Academy of Science and the specialist services of other Ministries and State Agencies (Forestry, Fishery, and Food Safety), but this produced very limited data. Currently only the State Service of Ukraine on Food Safety and Consumer Protection, which is responsible for state phytosanitary control, collects data on species from the national List of regulated harmful organisms, a large part of which is alien species. This State Service also conducts some practical work to control alien species. The compilation of existing data provides a baseline of current knowledge of alien species in the country, but to produce indicators and maps of these species requires an organized and funded system to obtain systematic observations and measurements. The planning and resourcing of this field data collection and compilation is considered to be the most challenging part of the information system to develop and maintain.
6. Delivery and management of the data on observations and measurements to make them into available data.	The data collected within the current project was compiled in an MS Excel database and submitted to the Global Biodiversity Information Facility (GBIF), so that is accessible online within Ukraine and internationally. The data management was conducted by the National Academy of Science and the NGO Ukrainian Nature Conservation Group, in co-ordination with the Ministry of Environmental Protection.

Information System Development Step	Activity and result
7. Obtain and analyze the available data to produce information products.	A book of 'Records of Alien Plant and Animal Species in Ukraine' was published. A first report was produced on the state of knowledge of AS and IAS and a preliminary list of priority IAS of concern, and possible indicators. The National Academy of Science is expected to analyze the data to produce reports, indicators and maps on IAS, in co-ordination with the Ministry of Environmental Protection. For the subject of the information system it is necessary to have technical experts available to guide its design and the production of information. There can be a challenge for this involvement of experts between the aims and structure of scientific institutes and the needs and operations of government agencies.
8. Communication of information products to the information users.	Reports and a preliminary database of IAS was submitted by the representatives of the National Academy of Sciences and the NGO Ukrainian Nature Conservation Group to the Department of Bioresources and Biosafety, Ministry of Environmental Protection and Natural Resources. Meetings were organized by the Ministry of Environmental Protection with the specialist services of other Ministries and State Agencies (Forestry, Fishery, Food Safety, etc.) on the state of knowledge of IAS in Ukraine, to obtain expert opinion on priority IAS for action, and to consider development of an IAS Strategy and Action Plan, including the establishment of an information system.
9. Making the data directly available to users	Alien species records (8,329) were made available through the website of the Global Biodiversity Information Facility (GBIF). https://www.gbif.org/dataset/36914742-56c5-4d54-a18a-6ab1e41b9240 DOI 10.15468/xfjq83

6. REFERENCES AND RESOURCES ON BIODIVERSITY INFORMATION DEVELOPMENT

6.1 References cited in this guide

D.W. Cash, W.C. Clark, F. Alcock, N.M. Dickson, N. Eckley, J. Jäger (2002) Salience, credibility, legitimacy and boundaries: Linking research, assessment and decision making. John F. Kennedy School of Government, Harvard University, Cambridge, MA

D.W. Cash, W.C. Clark, F. Alcock, N.M. Dickson, N. Eckley, D.H. Guston, et al. (2003) Knowledge systems for sustainable development. Proceedings of the National Academy of Sciences of the United States of America, 100, pp. 8086–8091

Mutsvangwa, Tendai, Muxe Gladmond Dlomu, and Adekunle Adebawale (2021) “Big Data in Biodiversity Science: A Framework for Engagement” *Technologies* 9, no. 3: 60. <https://doi.org/10.3390/technologies9030060>

UNEP-WCMC (2016) Indicators and Information Systems for biodiversity and development - guidance from the Pan European region. UNEP-WCMC, Cambridge, UK.

6.2 Useful organisations and information sources for biodiversity information development

Biodiversity Indicators Partnership (BIP)

www.bipindicators.net/

The BIP is a global initiative to promote the development, delivery, and use of biodiversity indicators. Its secretariat is hosted by UNEP-WCMC. The BIP website includes a framework and guides for the development of biodiversity indicators www.bipindicators.net/national-indicator-development

The Resources section of the website (<https://www.bipindicators.net/resources>) includes several guides for indicator development, including ‘Key knowledge for successful biodiversity indicators’ (<https://www.bipindicators.net/resources/national-resources/key-knowledge-for-successful-biodiversity-indicators>).

GEO BON Group on Earth Observations Biodiversity Observation Network

www.geobon.org

BON in a Box is a website that provides access to tool and guides on biodiversity observation design, data collection protocols, and data management, analysis and reporting. <https://boninabox.geobon.org/>

NatureServe’s Biodiversity Indicators Program.

<https://www.natureserve.org/communicating-status-and-trends>

This program oversees the development and use of indicators and provides support for building online tools to visualize biodiversity indicators.

Global Biodiversity Information Facility (GBIF)www.gbif.org

GBIF is an international network and data infrastructure funded by the world's governments and aimed at providing anyone, anywhere, open access to data about all types of life on Earth. It principally supports access to data on species. It conducts includes capacity development activities and one of its resources is an online capacity self-assessment tool for national biodiversity information facilities <https://www.gbif.org/tool/6Y2SqK8XokHUqIFUn6TLxX/online-capacity-self-assessment-tool-for-national-biodiversity-information-facilities>

National Ecosystem Assessment Initiativewww.ecosystemassessments.net/

The UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) hosts the National Ecosystem Assessment Initiative (NEA Initiative), to support countries conducting national ecosystem assessments to empower the full consideration of the value of nature in decision-making. The Resources section of its website includes a guide on 'National Biodiversity Platforms', with useful information on different institutional structures for providing biodiversity information. www.ecosystemassessments.net/resource/guidebook-on-national-biodiversity-platforms-connecting-nature-and-people/

UN Biodiversity Lab (UNBL)<https://unbiodiversitylab.org/en/>

The UN Biodiversity Lab provides over 400 spatial data sets in combination with analytic tools to generate insight and impact for conservation and sustainable development. It includes free workspaces for diverse stakeholders to use UNBL tools to visualize and analyze national data in combination with the global data layers. UNBL is available in English, French, Portuguese, Russian and Spanish.

IUCN SSC Species Monitoring Specialist Group (2023). Database of Global Data Sources for Biodiversity Conservation Monitoring.www.speciesmonitoring.org/data-sources.html**UN Economic Commission for Europe (2022) Guidelines for developing national biodiversity monitoring systems**https://unece.org/sites/default/files/2023-03/2228292_E_ECE_CEP_198_WEB%20rev.pdf**UNEP World Environment Situation Room provides data, information and knowledge on the environment**<https://wesr.unep.org/>**The UN SEEA Ecosystem Accounting (SEEA EA)**<https://seea.un.org/ecosystem-accounting>

The UN SEEA Ecosystem Accounting constitutes an integrated and comprehensive statistical framework for organizing data about habitats and landscapes, measuring the ecosystem services, tracking changes in ecosystem assets, and linking this information to economic and other human activity.

United Nations Statistics Division<https://unstats.un.org/UNSDWebsite/>

UNSD supports National Statistical Offices and systems, including for reporting on the Sustainable Development Goals (SDGs) <https://unstats.un.org/sdgs/unct-toolkit/data-resources/>

UN Women data portal<https://data.unwomen.org/>**FAO Food and Agriculture Statistics**<https://www.fao.org/food-agriculture-statistics/en/>**Partnership in Statistics for Development in the 21st Century (PARIS21)**<https://www.paris21.org/advanced-data-planning-tool-adapt>

The Partnership in Statistics for Development in the 21st Century has produced the Advanced Data Planning Tool (ADAPT) to help National Statistical Offices and other data producers within a country to effectively plan for data required by policymakers and to continuously monitor the progress.

7. USEFUL KNOWLEDGE FOR DEVELOPING BIODIVERSITY INFORMATION SYSTEMS AND PRODUCTS

This section of the guide presents some terms, concepts and lessons to support the development of information systems for government biodiversity policy processes.

It is important to recognize that global and national government biodiversity policy is not just concerning the status of species and ecosystems. It also involves meeting people's needs through sustainable use and

benefit-sharing of biodiversity. Equally, policy needs to be developed and implemented with equitable representation of different sectors of society, including women and men, and Indigenous Peoples and local communities. Therefore, information for biodiversity policy includes information on the people who benefit from biodiversity, with categorization by population group and gender where possible.

7.1 Information system framework

An information system organizes how information for biodiversity policy is produced, analyzed and made available.

UNEP-WCMC has developed an information system framework, to help develop the components and processes for a successful information system (Figure 3). If some of the components or linkages in

an information system are not developed or are not effective, then the whole system cannot function to provide the information needed. For example, there is often a lack of available data for use in indicators and reports. The framework diagram guides the definition of the needs and actions to have a functioning information system.

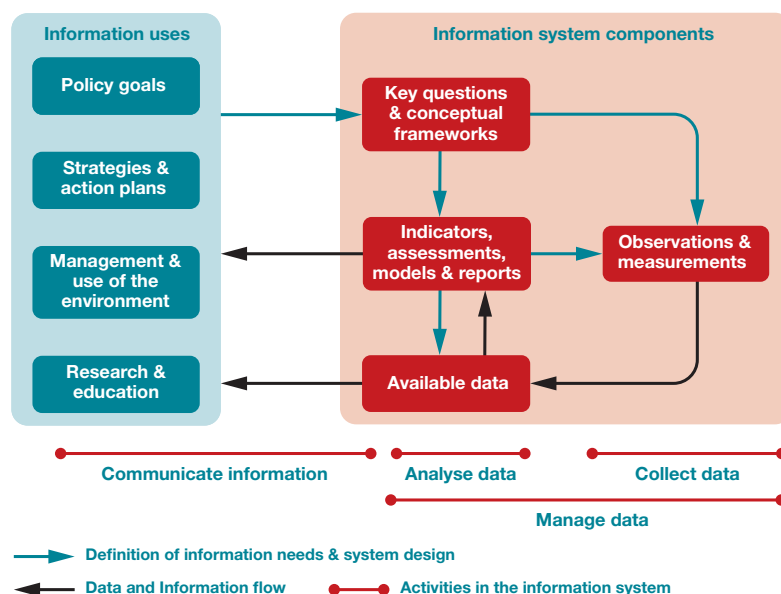


Figure 5. Framework showing the components, linkages and activities of an environmental information system. Source: UNEP-WCMC 2016¹.

¹ UNEP-WCMC. 2016. Indicators and Information Systems for biodiversity and development - guidance from the Pan European region. UNEP-WCMC, Cambridge, UK.

7.2 Data, information, knowledge

Government decision-making and policy implementation requires knowledge, information and data and it is important to understand how these concepts relate to each other.

An information system is designed to provide information and knowledge products for a particular purpose. The system includes the production and management of the data needed to produce the information.

Data – records, observations or measurements about something. For example, the number of animals in a location, or the numbers men and women in a meeting, or the digital data in a photograph.

Information – data that has been processed, summarized or analyzed to give it a meaning, or form. When data is processed to help inform someone it becomes information.

The processing of data into information is always in response to some kind of question. For example, “How has the number of animals in a location changed over time? The selection and analysis of data to produce information is guided by this question. The meaning given to the data as information is therefore context specific. For example, data on the number of animals in a location over time could be part of information on hunting pressure on those animals. Information can also be in a spatial form, such as maps. The information in a map is a selection and summary of data in response to a user’s question or need, such as wanting to know the locations of human infrastructure in a region.

Knowledge – contextualized information that helps bring understanding of a subject and make decisions about it. Knowledge can also be to ‘know how’ to do something, to have a skill, which is gained from experience and learning. For example, knowing how to interpret information on the abundance of an animal over time as part of decision-making on conservation actions for that species.

7.3 Information products

There are different types of information products, such as indicators, maps, reports, assessments, and models. An information product is what is provided for an information user to access the information.

The choice and design of information products will depend on the needs of the user, as well as their level of familiarity with the subject of concern. The effectiveness and availability over time of all types of information products can be strengthened using an information system approach.

7.4 Information should have relevance, legitimacy and credibility

For information to be useful to government it should have the following attributes (adapted from Cash *et al.* 2002 and Cash *et al.* 2003):

Relevance – the subject and format of the information is suitable for the decision-making or reporting need. In other words, the information user's key questions are being addressed.

Legitimacy – the process of producing the information is seen as trustworthy by the information users. This legitimacy is based upon who participated in the information production, how this participation was decided, and how the information is produced, checked and disseminated.

Credibility – the information is seen as meeting standards of scientific good practice and technical adequacy. This includes its data sources, analytical methods and interpretation.

The design of an information system can enable the information it provides to have these attributes, by:

- Including users and producers of the information in the definition of information needs and the design of the information system;
- Clearly identifying for information users the sources of data, how data were gathered and analyzed, and which organisations were involved in each stage. This helps to make the information credible and legitimate.
- Defining a mandated authority to lead the production of the information with suitable legitimacy.

It is also important to use best-practices for including Indigenous and local knowledge in information systems, and for addressing gender equality data gaps (e.g., related to land tenure and participation in decision-making processes).

7.5 Four capacity conditions for government biodiversity information availability

UNEP-WCMC has identified four government capacity conditions that enable suitable information to be available for biodiversity policy:

1 Commitment and authority to provide biodiversity information

A key factor of success is government commitment to having suitable information for its biodiversity policy needs. This commitment is stronger if it is included in relevant legislation and policy documents.

Such a commitment may be in response to international agreements, such as the Convention on Biological Diversity and its Kunming-Montreal Global Biodiversity Framework (www.cbd.int/gbf/), including its Target 21 on data, information and knowledge, and its Monitoring Framework.

A government also needs to designate an agency with the authority to lead and organize the production of information for biodiversity policy needs. This lead agency may work with many other agencies across government to address the range of subjects involved in biodiversity policy.

2 Resources to produce biodiversity information

The work of producing biodiversity data and information requires adequate resources of staff, office facilities and equipment. These resources are required for the collection, analysis and management of data, and the communication of information products. All these activities need to have long-term plans and funding. The successful production of biodiversity information often involves collaboration and sharing of resources by government agencies, non-governmental organizations, and academia.

3 Knowledge and skills to produce biodiversity information

The production of information for use in government biodiversity policy requires people with knowledge and skills to:

- a) Collect, manage and analyze data with scientific and statistically appropriate methods.
- b) Produce and communicate information products that meet user's needs and have scientific validity.
- c) Understand the topics of policy concern, to guide the design of scientifically and culturally appropriate data collection and analysis, and to invite the input of relevant experts.

Such knowledge and skills may all be held in government teams, but collaboration with experts in national and international organisations and academia is often beneficial. The provision of data and information products should also seek equitable representation of different sectors of society, including women and men, and Indigenous Peoples and local communities. The National Statistical Office can provide expertise in all stages of the production and communication of data for use by government, including data that relates to people.

4 Information systems to ensure useful information is produced

The many tasks and skills involved in producing biodiversity information for government require the institutions involved to work with a system approach. A government may have several information systems for different topics of biodiversity policy concern. An information system may include use of international data sets and indicators.

These four capacity conditions are integrated into the design of the tools and the specification templates presented in this guide.

7.6 Lessons for developing information products with an information system approach

Five lessons from UNEP-WCMC's experience in supporting government capacity for biodiversity information are:

1 Help decision-makers to answer their key questions.

Government decision-makers and managers want information that helps them meet their needs. Defining these information needs in the form of key questions is a powerful way to guide information production. Effective information systems are designed to help answer the key questions of specific information users.

The definition of key questions with information users can help to build their support for the operation of an information system.

2 Indicators need owners.

Indicators are a core part of an information system, to help summarize data to answer key questions. Government strategy documents may include the names of indicators for measuring progress, but often they do not specify which agency is responsible for providing the indicator results. If the indicator is not already calculated then it can become an 'orphan' without an institutional 'owner', and so is not produced.

Every indicator needs an institution that will 'champion' its production over time. This institution may carry out all the tasks for indicator production, or serve as a leader to organize the input of different groups for all the tasks involved.

3 Databases sit in information systems.

Many biodiversity databases are developed but not maintained. They may lack current data, or be inaccessible for government use, or not contain relevant data for government policy processes.

These problems are common for databases managed by government, academia and non-government organizations. A cause of this situation can be that the databases are not designed or operated for supporting government decision-making and reporting. As a result, there is little incentive for government to fund the maintenance of the database and the primary data collection.

Databases should be designed and managed as a tool for making available the data needed for decision-making and reporting. They should be viewed as a core part of an information system, and not as a product in isolation.

4 Invest in data collection.

Often one of the most challenging elements of a system to provide biodiversity information for government is the production of suitable observations and measurements. For this data to have scientific validity and government acceptance it needs to be collected using approved field protocols and appropriate spatial sampling.

To achieve national coverage of suitable data for many species and habitats can require considerable institutional organization and resources. New technologies, including remote sensing methods and artificial intelligence for data processing, are creating options for producing 'big data' on biodiversity (Mutsvangwa *et al.*, 2021), but resourcing and standards for primary data collection are often inadequate and require long-term funding.

When data has a clear value as the basis of information for government decision-making it is easier to make a case for investment in the data collection.

5 Build on the information capacity you have and learn by doing.

The tools and templates presented in this guide (Section 2) help to identify the needs and steps to build information capacity for a subject. It may often be the case that providing useful information requires better co-ordination of existing institutions and activities, or a greater focus on meeting the needs of information users. The skills and knowledge for developing information systems come from 'learning by doing' to produce information products.

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