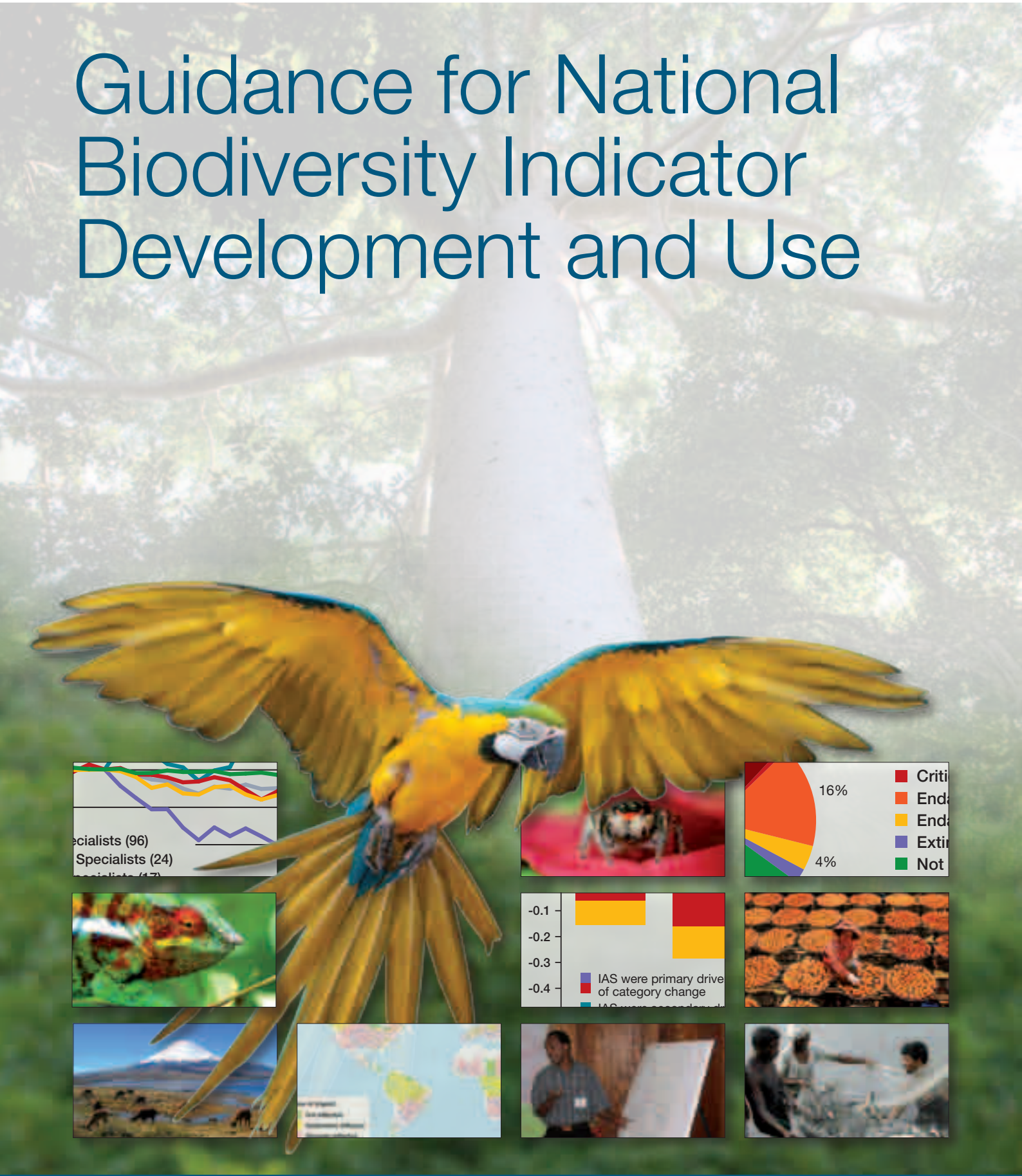
Biodiversity Indicators Partnership

Guidance for National Biodiversity Indicator Development and Use



www.bipnational.net

The Biodiversity Indicator Development Framework

The Biodiversity Indicator Development Framework contains key steps for producing successful biodiversity indicators. The Framework can be viewed as a map to this guide and is divided into three themes:

Purpose – actions needed for selecting successful indicators

Production – essential to generate indicators

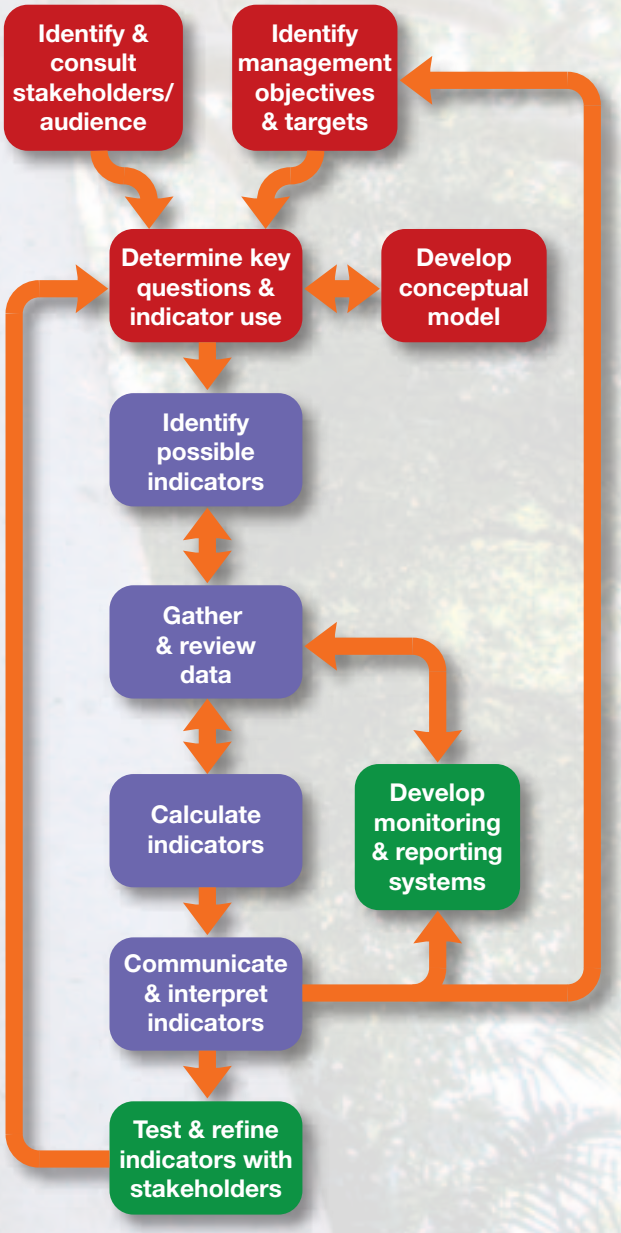
Permanence – mechanisms for ensuring indicator continuity and sustainability

It is important to recognise that the framework is an "ideal" standard and it may not be necessary to cover every step. However, in our experience, successful indicators are most likely to be achieved when all the steps have been considered.

Although presented in a logical sequence from top to bottom, there are other possible starting points and directions for using the framework. Indicator developers are encouraged to think of indicator development as an iterative process, which requires movement back and forth between the steps. For example, the steps 'identify possible indicators' and 'gather and review data' are often undertaken simultaneously.

Please remember that the purpose of the framework is not to produce indicators for their own sake, but to support informed, effective decision making and action for biodiversity conservation and sustainable use.

All steps in the framework are covered in detail in the second section of this guidance: *Developing and Using Indicators*.



For more information about the framework and national biodiversity indicator development visit the National Biodiversity Indicators Portal: **www.bipnational.net**

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Document development

This guidance document is one of a series produced with the support of the Biodiversity Indicators Partnership (BIP) as part of its 'global-national linkages' component. The ideas and experience reported in this guidance have been developed and tested in capacity building workshops for national government and NGOs agencies from over 35 countries in southeast Asia, the Caribbean, Central America, and eastern and southern Africa. The workshops have been organised with regional partners by UNEP-WCMC as part of the GEF-funded BIP. The workshops in Africa are supported by a UNEP project with funding from the UN Development Account.

This document responds to a mandate in the 2010 CBD Decision on Outcome-Orientated Goals and Targets (Decision X/7) to support '*national and regional efforts to establish or strengthen biodiversity monitoring and reporting systems to enable Parties to set their own targets and assess progress towards biodiversity targets established at national and/or regional level.*'

Much of the thinking on biodiversity indicator development presented here was first developed through a GEF project from 2002 to 2005 called 'Biodiversity Indicators for National Use' (BINU), working with partners in Kenya, Ukraine, Philippines and Ecuador and at PBL (Netherlands).

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Acknowledgements

The authors wish to express their deep gratitude to the many participants and collaborators in the BIP and BINU projects and workshops for sharing their experience and feedback for this document.

We also gratefully acknowledge the financial support of the Global Environment Facility (GEF), UNEP, European Commission and UN Development Account.

UNEP promotes environmentally sound practices globally and in its own activities. This publication is printed on paper from sustainable forests including recycled fibre. The paper is chlorine free, and the inks vegetable-based. Our distribution policy aims to reduce UNEP's carbon footprint.

Further information

This document is one of a series of BIP guidance materials and fact sheets to assist Parties to the Convention on Biological Diversity (CBD) to track their progress towards the CBD 2020 Aichi Biodiversity Targets.

More information and examples to support national biodiversity indicator development are available from the National Biodiversity Indictors Portal: *www.bipnational.net*.

Please contact *info@bipindicators.net* to send feedback, questions and suggestions for improvement of this guidance, or to find out how your regional or national work could be included in the BIP website.

Citation: Biodiversity Indicators Partnership. (2011) Guidance for national biodiversity indicator development and use. UNEP World Conservation Monitoring Centre, Cambridge, UK. 40pp

Version 1.4
March 2011

Information about the Biodiversity Indicators Partnership is available on the internet: *www.bipindicators.net*

Published by UNEP–WCMC (*www.unep-wcmc.org*)

Key messages for developing and using biodiversity indicators

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

Since indicators are purpose-dependent their development or selection should start with identifying the issue or decision-making need that the indicator will address. Describing this need in the form of a '**key question**' helps to guide indicator selection and communication.

There are almost always some relevant data available to start producing biodiversity indicators.

Understand your data – their strengths, their limitations, and where they have come from.

The same data can be used in an indicator for multiple purposes.

When selecting and presenting indicators think about the '**story**' or narrative that you want to tell to the user about the subject.

An indicator fact sheet helps to guide the development of an indicator and helps others to continue its production in the future.

Indicators are part of a process and should lead on to informed decisions – they are not ends in themselves.

Introduction

This guidance is designed to help the development of biodiversity indicators at the national level for uses such as reporting, policy-making, environmental management, and education. It is intended principally for the people who produce biodiversity indicators, whether they are in government agencies, academia or NGOs. In some cases biodiversity indicators are developed on a 'one-off' basis to meet the needs for a particular study or report, or they can be developed for long-term reporting and decision-making. This guidance can be used for both situations.

This document has been separated into two clear sections for ease of use. The first defines what an indicator is and then examines the multiple uses of biodiversity indicators, such as for reporting and management.

The second section should be considered as the practical component and is organised around the Biodiversity Indicator development Framework (inside cover) which presents a series of key steps in successful indicator development.

These steps may be used as a guideline for the production of an individual indicator, or for a suite of indicators brought together to answer a specific question. Detailed information is provided for each step, including identifying indicator needs and key questions, gathering and analysing data, testing results, and the communication of indicators.

The focus of the guidance is on the process aspects of producing and using indicators, rather than technical aspects such as different measures of biodiversity.

The overall aim is to assist in the production of successful biodiversity indicators at the national level. By 'successful' we mean indicators that are actually used to support policy and decision making, whether this be in reports on progress towards targets, analysis of important issues, or in education and the news media. Successful indicators are also produced on a regular basis, so that they can be used to track change over time. This guidance covers the range of such factors that contribute to the success of indicators, including scientific validity, sensitivity to change in the issue of concern, and the existence of a 'champion' institution responsible for their continued production and communication.

Sometimes biodiversity indicators are developed within frameworks for analysis and reporting such as the Pressure-State-Response framework, or the framework of Strategic Goals and indicators for the Convention on Biological Diversity 2020 Aichi Targets. We do not aim to describe all these frameworks, but will make reference to them.

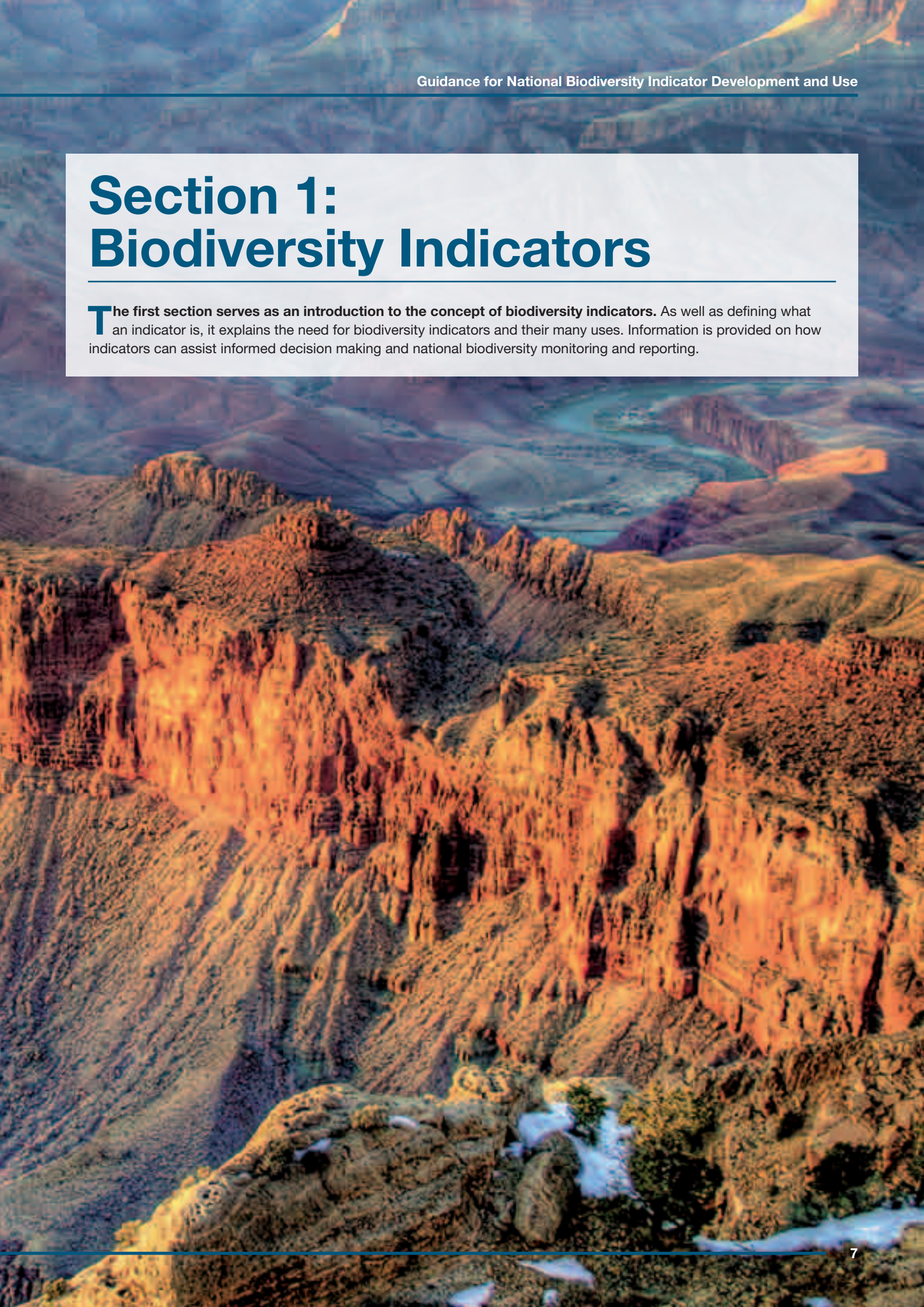
This document complements the information available on the National Biodiversity Indicators Portal (*www.bipnational.net*).

'There is no way to ensure better conservation, sustainable use of biological diversity or equitable sharing from the utilization of biological resources if countries don't have clear biodiversity indicators'

Rwandan participant,
Biodiversity Indicators Capacity Strengthening in Africa project

Section 1: Biodiversity Indicators

The first section serves as an introduction to the concept of biodiversity indicators. As well as defining what an indicator is, it explains the need for biodiversity indicators and their many uses. Information is provided on how indicators can assist informed decision making and national biodiversity monitoring and reporting.



What is an indicator?

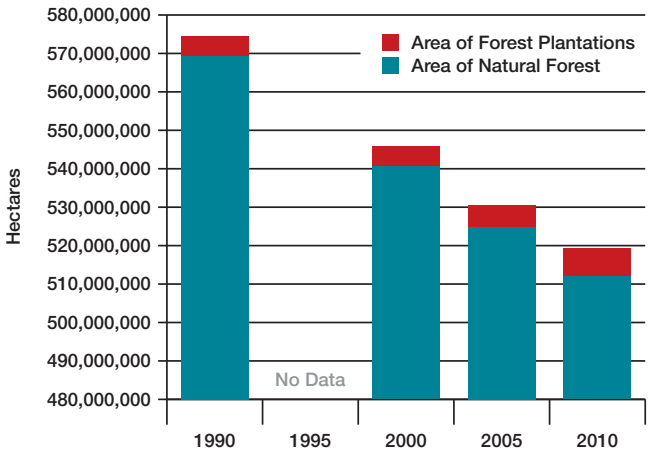
For the purpose of this guidance we define an indicator as, "a measure based on verifiable data that conveys information about more than itself". Examples of indicators from subjects other than biodiversity are a person's body temperature as an indicator of his or her health, or the level of unemployment as an indicator of the status of a country's economy and the well-being of its population. In some cases information from several different measures or data sets can be combined to form an index, such as the Consumer Price Index which indicates the inflation rate of a national economy.

Biodiversity indicators can also be simple measures or more complex indices. For example, population estimates of the large cat species in a country could be a relatively simple indicator of the integrity or health of terrestrial ecosystems. The Marine Trophic Index can be an indicator, or proxy, of the integrity of marine ecosystems, calculated from data of harvested fish and their average trophic level (such as herbivores and carnivores) in the food web.

The general term 'biodiversity indicators' as used in this document and by the Convention on Biological Diversity (CBD) covers more than direct measures of biodiversity itself, such as species populations and extent of ecosystems. It also covers actions to ensure biodiversity conservation and sustainable use, such as the creation of protected areas and regulation of the harvesting of species, and pressures or threats to biodiversity such as habitat loss.

Since indicators are measures of something, they can usually be presented in a numerical or quantitative form. A line graph is perhaps the most common form of presentation, but other forms such as a pie chart or map may sometimes be clearer and have greater impact.

Figure 1. Forest area estimations for Brazil, 1990 - 2010[1]



Important Definitions:

A measure: a standard unit used to express size, amount or degree
A metric: a system or standard of measurement
An indicator: a measure or metric based on verifiable data that conveys information about more than itself
An index: a numerical scale used to compare variables with one another or with some reference number

Probably the most important part of the indicator definition is that the data conveys information about more than itself. This means that **indicators are purpose-dependent** - the interpretation or meaning given to the data depends on the purpose or issue of concern. For example, data on forest extent (Figure 1) could be interpreted as an indicator of the following issues, depending on the purpose of the analysis or the issues of concern:

- change in availability of forest resources
- progress in forest conservation
- intensity of threats to forest ecosystems
- results of investments of plantations
- change in soil cover and erosion
- change in forest carbon sequestration
- likely changes in conservation status of forest dependent species.

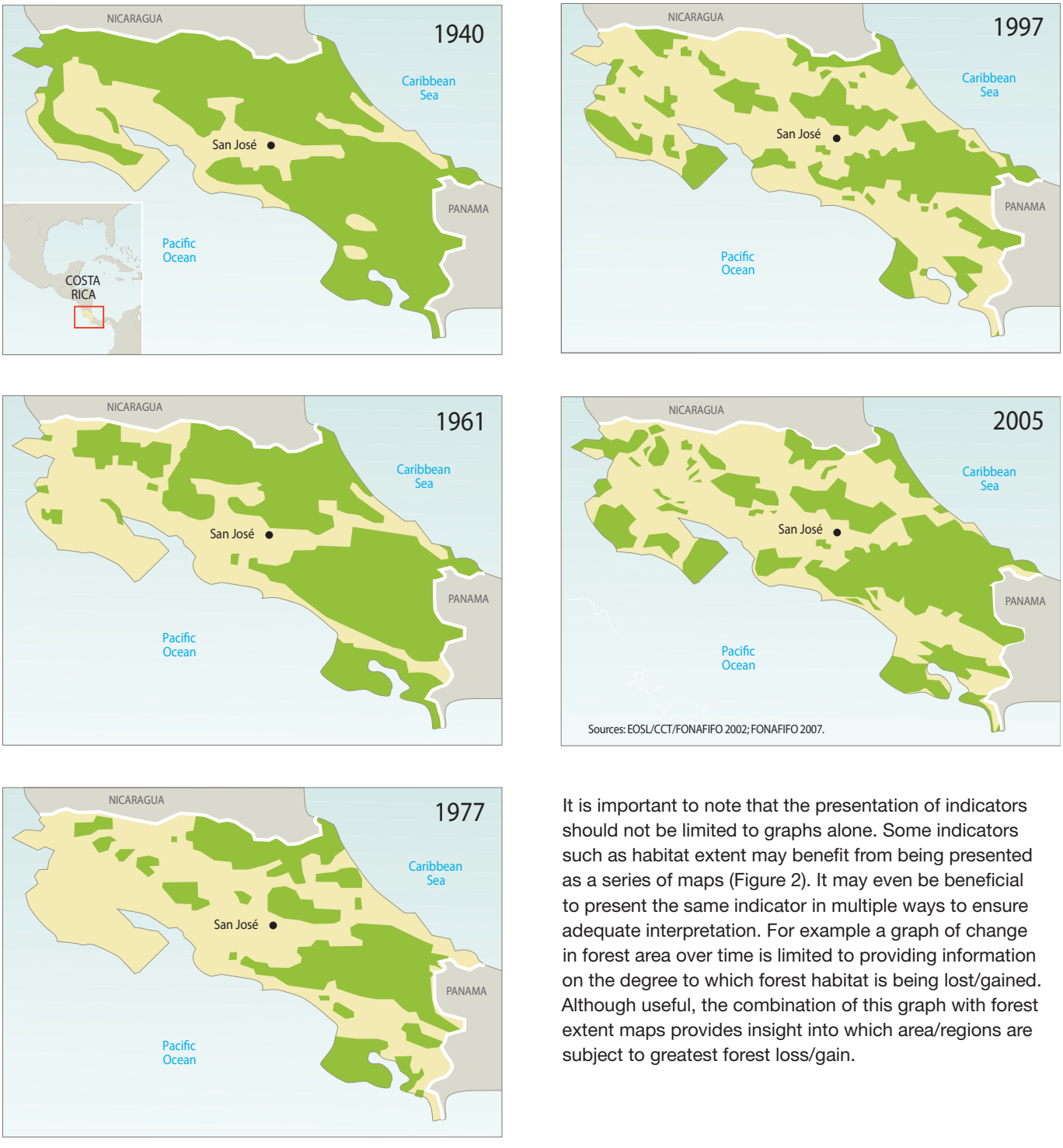


Figure 2. Costa Rica Forest Cover, 1940-2005[2]

It is important to note that the presentation of indicators should not be limited to graphs alone. Some indicators such as habitat extent may benefit from being presented as a series of maps (Figure 2). It may even be beneficial to present the same indicator in multiple ways to ensure adequate interpretation. For example a graph of change in forest area over time is limited to providing information on the degree to which forest habitat is being lost/gained. Although useful, the combination of this graph with forest extent maps provides insight into which area/regions are subject to greatest forest loss/gain.

References

[1] FAO. 2009. Global Forest Resources Assessment 2010: Brazil Country Report. http://www.fao.org/forestry/20262-1-206.pdf

[2] UNEP/GRID-Arendal, 2009/ Change Forest Cover Costa Rica, UNEP/GRID-Arendal Maps and Graphics Library, http://maps.grida.no/go/graphic/change-forest-cover-costa-rica

Who uses biodiversity indicators?

Biodiversity indicators can be used by almost any sector of society and the following are some typical uses. National and regional governments use indicators to help make policies for biodiversity conservation and sustainable use. They can also use the indicators to seek support and justification for their decisions, and to report on the impact of their policies. The news media may also use these indicators in their reports on environmental issues and government actions. Non-governmental organisations may use indicators produced by the government or from their own work to raise awareness about biodiversity issues, and to hold governments to account on their policies. Universities and other educational institutions may use biodiversity indicators as part of their teaching on biodiversity. Research institutions and commercial consultancies may produce and use indicators as part of their analyses and reporting of environmental issues, including for environmental impact assessments.

Who develops biodiversity indicators?

Some governments have specific units or staff responsible for the production of national biodiversity indicators, with a mandate to gather data and publish the indicators on a consistent basis over time. Such government indicators may be validated by the national statistical agency and also included in their reports.

Other governments may produce biodiversity indicators on a less systematic basis as demand arises, such as reporting to an international environmental agreement or developing a new policy. If they do not have sufficient capacity themselves, the government department responsible for biodiversity issues may contract a consultancy or university to assist in the production of indicators and biodiversity reports. Most governments will also produce some biodiversity indicators or biodiversity-relevant indicators in departments such as forestry, fisheries and maybe agriculture and land use planning.

Some national and international biodiversity non-governmental organisations (NGOs) produce indicators. This may be to raise awareness and provide evidence for issues of their concern, and to demonstrate the impact of their actions and get more support. Such NGOs usually have a few technical staff responsible for the gathering, analysis and communication of their scientific and survey data, including the use of indicators.

Universities and other research institutes may also develop biodiversity indicators, although this is more likely to be on an ad-hoc basis for specific studies rather than a regular and long-term monitoring and reporting of the same indicators.

The production and reporting of biodiversity indicators may be most successful by working in partnerships, to provide the necessary capacity, data and technical expertise. Some partners may be directly involved in the development of the indicator and the provision of data. Other partners may be external to the development process as providers of funding or users of the end products.

The skills required for biodiversity indicator development include:

- a science-based understanding of the biodiversity issue of interest,
- understanding the scientific and statistical strengths and weaknesses of the data being used,
- a basic competency in the processing of data to produce graphs and maps, etc with a scientific and statistical validity,
- writing and presentation skills to communicate the indicator results to the intended users.

Uses of indicators

Indicators are a central part of effective decision-making and adaptive management. They can provide measures of the progress and success of policies, as well as form part of an 'early warning system' to detect the emergence of problems. They can also be used to raise awareness about an issue and put responses to it into context. Through all these functions, indicators provide an important interface between policy and biodiversity-related science, to help simplify this complex subject.

In some cases biodiversity objectives and policies result from scientific research which identifies new and emerging issues, such as climate change or the impacts of invasive alien species. Indicators can play a central role in the communication of these new concepts and increase the effectiveness of responses to mitigate changes.

Indicators by themselves, however, provide little understanding of an issue. They always need some analysis and interpretation of what they are indicating. Indicators with their interpretative text can then be part of the definition of targets or objectives. Caution is required, though, if targets are set on the basis of a desired value of an existing indicator, especially if the indicator has been chosen principally because it is something for which there is existing data. It is important to determine the desired state of the subject which the indicator is just an indicator of! For example, a certain abundance of lions in an area may be decided as a target, when actually the desired aim is a savannah ecosystem able to sustain all native wildlife species as well as livestock grazing and tourism. A management target for just a desired lion population may result in actions that conflict with other objectives for the area.

One of the common uses of biodiversity indicators is to track progress towards global and national targets. These targets range from action plans at a local level, through National Biodiversity Strategies and Action Plans (NBSAPs), to the decisions of international agreements such as the CBD. The use and the international profile of biodiversity indicators has increased considerably since the Parties to the CBD committed themselves in 2002 to, "achieve by 2010 a significant reduction of the current *rate* of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth". In 2010 the international profile for indicators was further strengthened with the adoption of the CBD Strategic Plan for 2011-2020 which includes 20 new targets, known as the Aichi Biodiversity Targets, to be achieved by 2020.

At the national and regional scales, the requirement to report on progress in meeting the 2010 Biodiversity Target has been a major force in promoting the development of biodiversity indicators. In some cases countries have adapted existing data and indicators to the CBD framework of goals, targets, focal areas and global indicators for their reports to the CBD. This impulse to produce biodiversity indicators is likely to continue with the adoption of the Aichi Biodiversity Targets.

What is a successful indicator?

The participants in the 2010 BIP capacity building workshops identified that a successful indicator should be:

- **Scientifically valid** - a) there is an accepted theory of the relationship between the indicator and its purpose, with agreement that change in the indicator does indicate change in the issue of concern; b) the data used is reliable and verifiable.
- **Based on available data** – so that the indicator can be produced over time.
- **Responsive to change in the issue of interest.**
- **Easily understandable** – a) conceptually, how the measure relates to the purpose, b) in its presentation, and c) the interpretation of the data.
- **Relevant to user's needs**.
- **Used!** - for measuring progress, early-warning of problems, understanding an issue, reporting, awareness-raising, etc.

Section 2: Developing and using indicators

This section explains the different steps of the Biodiversity Indicator Development Framework (inside cover). The framework is divided into three themes:

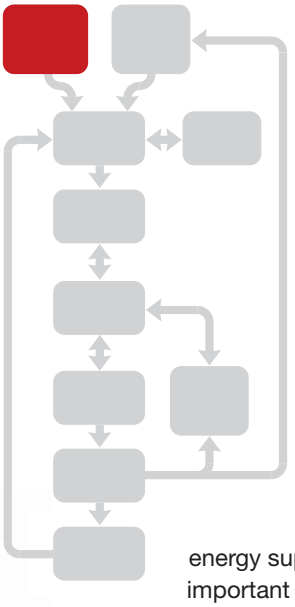
- **Purpose** – actions needed for selecting successful indicators
- **Production** – essential to generate indicators
- **Permanence** – mechanisms for ensuring indicator continuity and sustainability

The framework has been developed from the experience of the 2010 Biodiversity Indicators Partnership, UNEP-WCMC and their partners.

Identify and consult stakeholders and the target audience

Indicators should be chosen to meet the needs of specific users

It is strongly recommended that stakeholders are consulted as early in the indicator development process as possible in order to determine the purpose of the indicator and its audience. These stakeholders may be direct users of the indicator, those with a broader interest in the issues surrounding it, and those holding relevant data. Consulting with these groups and identifying their needs will also help to define how simple or complicated the indicator can be, and the most appropriate ways of communicating and interpreting it.



There are many different groups with interests in biodiversity who could use information generated from biodiversity indicators. Some of these are obvious, such as government biodiversity conservation agencies, conservation-focused non-governmental organizations (NGOs), and relevant departments in universities and research institutions. Others, including government agencies responsible for agriculture and land-use planning, agencies involved in rural development, and indigenous peoples groups, may be less apparent. Many groups also have an important direct or indirect impact on biodiversity without necessarily having a conscious interest in it, such as those involved with road construction or energy supplies. These are potentially some of the most important groups to reach in communicating information about biodiversity and involving them in relevant decision-making, but can also be some of the hardest stakeholders to engage with. Some important groups may be surprising at first sight, for example in Ukraine the military have been engaged in the production of agrobiodiversity indicators as they have responsibility for large areas of land whose management is important for species in agricultural landscapes.

Many stakeholders may not in the first instance be clear what questions they have regarding biodiversity-related policies and management. They may also differ widely in their awareness and understanding of the relationships between biodiversity and their own interests. The presentation of existing biodiversity information and potential indicators can help to stimulate stakeholders' thinking and awareness of questions that may be important to them. This requires the teams leading the process to take a proactive role, which inevitably means that their own values and interests will come to the fore. This is not necessarily a problem provided that it is openly acknowledged and that teams make every effort to respond to others' ideas.

One major barrier between indicator development teams and other stakeholders can be a lack of common concepts and understanding of what biodiversity is and why it is important to each group. It is therefore essential to discuss these issues from the beginning of the indicator development process so that stakeholders, including the indicator development team, understand these concepts as clearly as possible. Due to the multidimensional nature of the term biodiversity and the different value sets of each group involved, ultimate agreement on all terms and issues may never be reached. If this occurs it is important to acknowledge that there will be some areas where individuals and groups will have to agree to disagree.

Consultations need to manage stakeholder expectations

The consultation process should include managing the expectations of stakeholders regarding the level of detail of analyses and indicators that will be produced, if any input is required from them, and whether the indicator will result in new resources being made available.

Consultations with stakeholders may well overlap in time and purpose with the indicator development step "Identify management objectives and targets". Both of these steps will enable the following step "Determine key questions and indicator use". Some stakeholders, such as a national statistical agency, may want to be consulted at every stage of indicator development. After the initial consultations most stakeholders will only have the time or interest to be consulted again on the utility of the final products for their needs, which is the step at the bottom of the indicator development framework, "Test and refine indicators with stakeholders".

"Make sure that key stakeholders (government and other relevant interested parties) are involved and have a shared sense of ownership of the process."

Ed Mackey, Scottish Natural Heritage (SNH)

Questions to ask during this step:

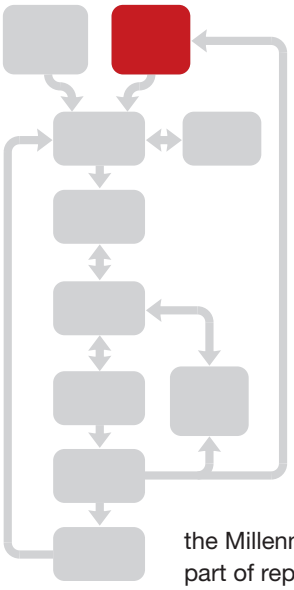
- *Who are the relevant stakeholders, and do they all need to be consulted?*
- *What questions do the stakeholders want answers to regarding the biodiversity issue of concern?*
- *How will the stakeholders want to use the indicator(s)? e.g. for decision-making, for reporting, for education.*
- *Have the inputs, expectations and outputs of the indicator development process been clearly defined for the stakeholders?*
- *How much ownership and decision-making power are different stakeholders going to have over the choice of indicators?*

Identify management objectives and targets

An important role of indicators is to support adaptive management to achieve objectives and targets

Some indicators are designed to encourage awareness and understanding about an issue but different indicators may well be needed for decision-making on objectives and management actions. For example, the Living Planet Index (LPI) provides a single index value of the trends in abundance and distribution of selected vertebrate species for which there are suitable data sets. Changes in the LPI are an indicator of overall biodiversity loss or gain and this information is important for raising public and policy makers' awareness of the issue, but the index value alone does not explain why there is biodiversity loss or gain or what objectives or actions there should be to address this.

When biodiversity indicators are developed to support decision making and management the definition of the purpose and users of such indicators should start with identifying already agreed objectives and targets.



All countries have management objectives and policies with direct or indirect impacts on biodiversity and reporting on progress towards these is a major role for biodiversity indicators. Key biodiversity management policies include National Biodiversity Strategies and Action Plans (NBSAPs), protected areas systems plans and endangered species legislation. Relevant documents in other natural resource management sectors include national forest plans, fisheries policies, water policies, land-use plans and environmental impact legislation.

Some national objectives may have been adapted from the targets and plans of international agreements such as the CBD or the Millennium Development Goals. Indicators are a key part of reporting on national progress to such international agreements.

In reality, national biodiversity-relevant policies and management are scattered across a wide variety of sectors. However, a common problem is that policies often lack clearly stated objectives, explicit targets or specified mechanisms for measuring progress, so the definition of indicator needs is not always straightforward. In such cases indicators may still serve to raise awareness and understanding of the policy issue and support future definition of objectives and strategies.

If this step has not identified relevant management objectives and targets then it may need to be combined with the step "Identify and consult stakeholders/audience" to obtain more information to define the purpose of the indicator(s).

This indicator development step leads onto the step "Determine key questions and indicator use".

Questions to ask during this step:

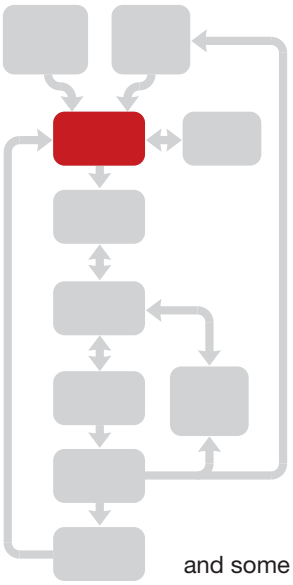
- *What are the existing biodiversity-relevant management objectives and targets in our country?*
- *Who wants to know about progress in reaching these objectives and targets?*

Determine key questions and indicator use

Indicators are best designed and communicated to help answer users' key questions

Determine key questions

It is strongly recommended to develop and communicate biodiversity indicators in response to key questions. A key question describes what the user or audience for the indicator wants to know about the subject. It helps to define what the purpose of the indicator is, and since indicators are purpose dependent this is very important.



Key questions can be very general, such as:

- *How many species are there in our country?*
- *Which species are threatened with extinction?*
- *What are the priority areas for biodiversity conservation?*
- *Is biodiversity increasing or decreasing in our country?*

There may be several indicators and data sets that help to answer a single key question. One of the benefits of defining a key question is that it naturally encourages the selection and communication of the indicators in a form that aids their interpretation. Usually some form of narrative text accompanies the presentation of an indicator, to explain the significance of a trend line on a graph, for example. The writing of this explanation is easier when it is in response to a key question. The logic of addressing a key question also encourages further analysis and the use of more than one indicator to explain complex issues.

If key questions are more precise and specific to a situation this gives more guidance for the selection and development of suitable indicators. More specific key questions are often about management issues, such as:

- *What are the main threats to biodiversity in our area?*
- *What is the sustainable catch level for this fishery?*
- *What is the status of the important wildlife for our tourism industry?*

"Keep to a small number of indicators, making sure you only have indicators that answer a specific question or meet a clearly-defined need."

Jessica Grobler, SANBI

Objectives and targets can be rephrased as questions to help identify indicators for them. For example:

- *Have we achieved the CBD's Aichi Biodiversity Targets and as a result its mission to halt the loss of biodiversity?*
- *Is our elephant population within the target range of 15,000 to 20,000 animals?*
- *Have we achieved our target of at least 10% of all our ecosystems included in our protected areas system?*

The definition and prioritisation of key questions should ideally be an iterative process of consultations with the stakeholders and audience for the indicator(s). Initially a great variety of questions may be identified, and some of them may be so broad or complex in their scope that they may not be best answered using indicators. The indicator development team may need to build shared understandings of the issue and manage the expectations of all involved. It may be that the agreed need is not just the development of indicators, but for their use as part of a detailed analysis and report in response to the key questions, or the need is first for the gathering of field data.

Analytical and Reporting Frameworks

Sometimes biodiversity indicators are selected and presented within frameworks for analysis and reporting such as the Pressure-State-Response (PSR) framework, or the DPSIR framework which includes 'driving forces' and 'impacts' of environmental change. The PSR framework is based on a model of the world where human activities exert pressures (such as pollution emissions or land use changes) on the environment, which can induce changes in the state of the environment (for example, pollutant levels, habitat diversity, water flows). Society then responds to changes in environmental pressures or state with policies and programs intended to prevent or reduce environmental damage. The structure of many reports on the state of the environment, and the framework of focal areas and indicators for reporting on the CBD's 2010 Target (see www.twentyten.net), have been organised using a PSR framework and its variants.

Analytical and reporting frameworks such as PSR can be helpful in identifying important questions which indicators can help to answer. However, there is often a tendency to try and assign particular indicators to one or other of the categories of the framework. Unless particular indicators have been specified for use in a report, it is recommended that such frameworks are used only to help identify and group key questions, but not for the classification or selection of indicators. This is because indicators are purpose-dependent and so the same measure can be used in two or more of the PSR categories. For example, data on forest extent could be used as an indicator of rates of habitat loss (pressure), as an indicator of habitat suitable for forest-dependent species (state), and as an indicator of the effectiveness of policies to stop deforestation (response).

Determine indicator use

The definition of a key question helps to determine the use of an indicator. Will it be used for measuring progress, early-warning of problems, understanding an issue, reporting, or awareness-raising? If it is to be used for management decision-making, will it be used on specific occasions when decisions are made or progress reported, such as an annual review of a programme of work? Who specifically will be using this information? What levels of education and familiarity with the subject does the intended audience already have?

The more the intended use of an indicator can be detailed the easier the subsequent steps of indicator development and communication will be, and the greater likelihood of the indicator having an impact and being used over time.

Questions to ask during this step:

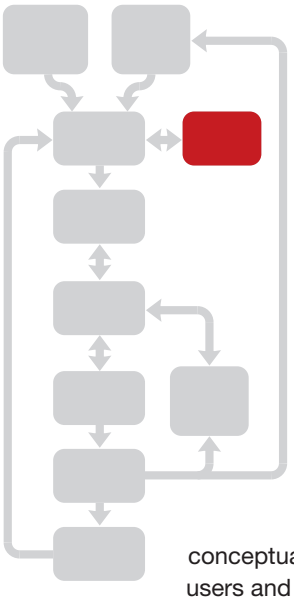
- *What are the key questions that the intended user or audience have about the biodiversity issue?*
- *Can the key questions be made more specific or focused?*
- *How will the indicator be used?*
- *Who will be using the indicator?*
- *What levels of education and familiarity with the subject does the intended audience already have?*

Develop a conceptual model

A conceptual model helps to select and communicate indicators in response to key questions.

As biodiversity indicators are purpose-dependent, the relationship between the measure chosen as an indicator and the indicator's purpose needs to be scientifically valid and easy to understand. This is especially important for such a complex concept as biodiversity, which is open to multiple interpretations and is often difficult to communicate.

To help determine and explain the relationship between an indicator and its purpose a conceptual model of the issue of concern is very helpful. A conceptual model is basically a diagram that represents the main issues of concern and how they are related to each other. Typically the diagram has each issue in a box or circle and the relationships between them are shown by arrows or lines. Accompanying text can give further explanation of the diagram.



A conceptual model diagram helps to clarify the subject being addressed for all involved and aids in the selection and communication of appropriate indicators. It helps in assessing the suitability of potential indicators to answer the key question(s) and their scientific validity, considering how effectively they represent the issue of concern and respond to any change.

A conceptual model can also guide how to structure the explanation of an issue and the meaning of the indicators. The model may be presented as a diagram in a final report to assist to help develop the narrative.

Conceptual model development starts with clarification of the key questions

The starting point in the production of a conceptual model is the key question(s) of the indicator users and any management objectives that have been identified. From these the scope or boundaries of the subject (e.g. site-specific or national) can be defined. The main subjects or issues in addressing the key question(s) are then identified. These issues and their relationships are then drawn on a preliminary diagram for discussion by the indicator development team, and ideally with the users of the indicator. The conceptual model is then reworked and refined, helping to build a clearer and shared understanding of the subject. This process may lead to changes or further definition of the key questions. At the stage of indicator selection there could potentially be indicators for each of the issues in the conceptual model and for the lines or linkages between them.

For a very specific key question the conceptual model can be a simple one. For example, for the question, *"Have we achieved our target of at least 10% of all our ecosystems included in our protected areas system?"* Figure 3 could be a conceptual model of the issues involved. Data could be gathered for each of the boxes or issues and the indicator is for the relationship between the issues, which would probably involve a GIS overlay analysis.

Figure 3. An example conceptual model to guide indicator development for the key question, "Have we achieved our target of at least 10% of all our ecosystems included in our protected areas system?"

Figure 4 is an example conceptual model diagram produced to examine some more general key questions about a country's protected areas (PAs) system, such as: *"what is the status of our protected areas (PAs)?"*, *"what benefits do our PAs provide for local communities?"*, and, *"what are the management priorities for our PAs?"*. Indicators could potentially be produced to describe each box or issue in the diagram. The interpretation of the indicator values and trends will be helped by considering the relationships between the boxes or issues.

A conceptual diagram can be confused with analytical and reporting frameworks such as Pressure-State-Response (PSR). The difference between them is essentially one of scale, as there is some overlap in their use. Analytical frameworks such as PSR are a very broad guide to help organise key questions and analysis of a wide subject, such as the state of the environment. A conceptual model diagram as described in this guidance is a more detailed representation of the specific issues resulting from addressing a key question. A very general key question may be first explored with a general conceptual model of the subject of the question to give an overview, and then more detailed models of the individual issues.

Questions to ask during this step:

- *Which are the most important or over-arching key questions that can be examined with the aid of a conceptual model?*
- *What level of detail is required for the conceptual model?*
- *Who should be involved in the definition of the conceptual model?*

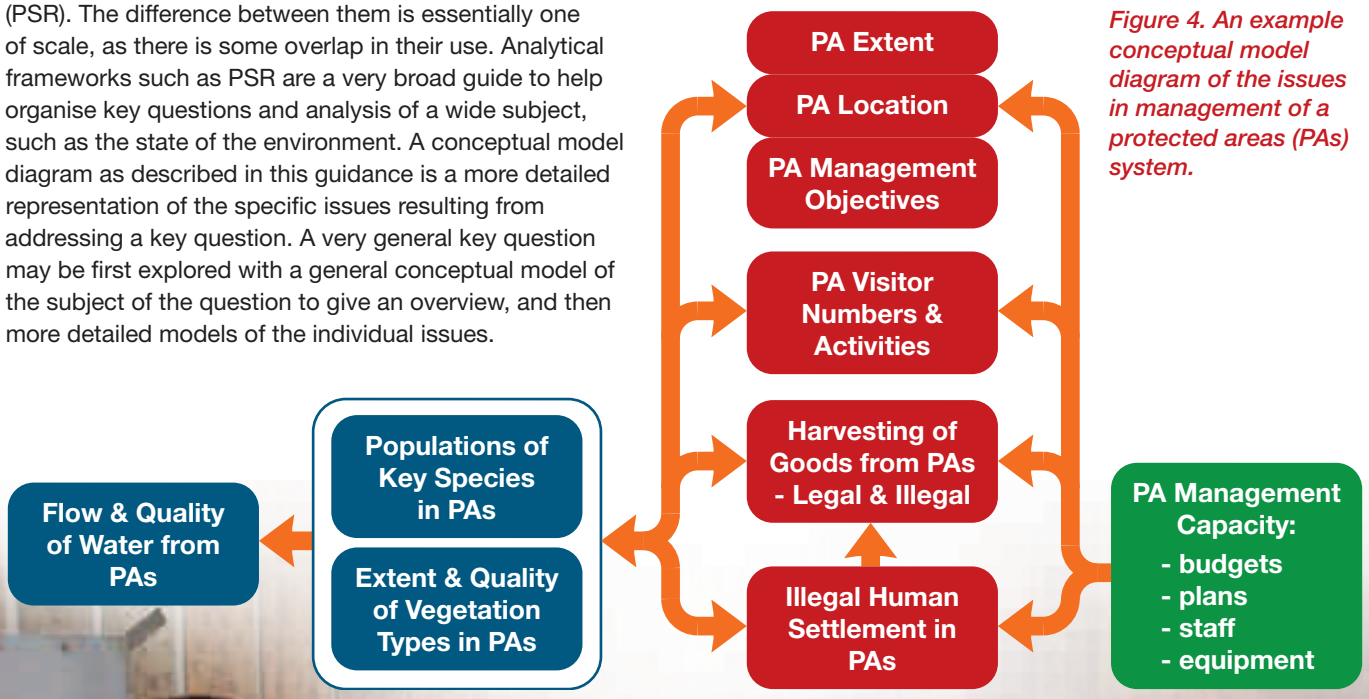


Figure 4. An example conceptual model diagram of the issues in management of a protected areas (PAs) system.

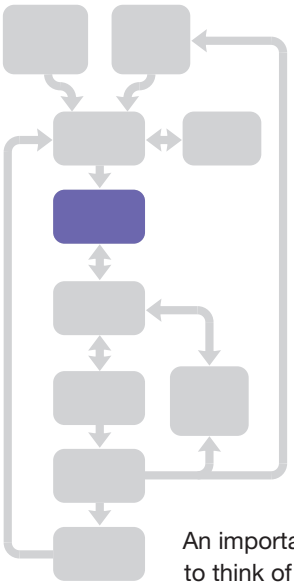
Identify possible indicators

Both new and existing indicators can help to answer a key question. Their feasibility and sustainability need to be assessed.

Identifying indicators that respond to specific key questions and user needs is most successful with a combination of creative thinking and scientific rigour. Creative thinking may be a surprising skill in this context, but the indicators with the greatest impact are often produced by using and presenting data in novel ways, including combining different kinds of data in ways that may not seem immediately obvious. Scientific rigour is necessary to identify indicators that are conceptually valid and defensible for their purpose.

Appropriate indicators also need to be responsive to change in the issue of interest and easily understandable to the user.

This step will probably be carried out in combination with the step "gather and review data", as the data searches will be guided by needs for possible indicators, whilst actual data availability and suitability will limit the number of feasible indicators. A conceptual model diagram helps to guide the selection of suitable indicators and data sets.



It is important to consider indicator presentation

One consideration in the identification and creation of possible indicators is how they will be presented to the users. Most biodiversity indicators can be classified into two fundamental types: either map-based and spatial indicators or graph and index-based indicators. Map-based indicators often have a considerable initial appeal to end-users. However, because much GIS work is relatively new, map-based data sets often do not exist as time series, but rather as single data sets that cannot demonstrate change over time. Nonetheless, reliable snapshot maps can be useful as baselines against which to monitor future change.

An important aspect of indicator development and use is to think of this work in terms of a 'story' or narrative that you want to tell to the user about the subject. The previous steps in the process will have started to outline the scope of the 'story' that will seek to answer the key question(s). The selection and creation of indicators should consider how they can detail and communicate the 'story'. It is also important to remember that one indicator will never tell you all you want to know, as it is just indicating another, often more complex, issue.

Although a country needs to select indicators firstly to meet its own needs, there can be advantages to choosing indicators that are also used for reporting on global targets or which are used by neighbouring countries. On a practical level, using tried and tested methods potentially reduces the time spent on indicator development. On a broader level, contributing national level data or indicators to regional or global scale initiatives benefits both parties. The regional or global initiative is strengthened by the addition of national scale data and the results of the national level indicator initiative can be put into a broader context. A strong example of a regional scale indicator process is the Streamlining European Biodiversity Indicators (SEBI) project, which developed a set of 26 proposed indicators to monitor and report on progress to achieve the European biodiversity targets.

"Indicators should provide telling insights into the natural world. They must be policy-relevant but also realistic in terms of data availability."

Ed Mackey, Scottish Natural Heritage (SNH)

"The idea of a headline suite of indicators, easily understood and communicated to all, supported by a lower tier to aid interpretation and provide more detail, has proved to be a robust model and the most effective solution for communicating such a difficult subject to such a wide audience."

James Williams, JNCC, UK

The selection of the most suitable indicator or indicators may be the responsibility of a single institution, or it might be decided by a committee with representatives from multiple organisations or research groups, such as a steering or advisory committee. Each stakeholder may have a different perspective and there may be many different suggestions of how to approach the problem and how best to answer the key question. Input and critique of this kind is always valuable, but ultimately an indicator or suite of indicators must be decided upon and an approach agreed before the project can move forwards to the next stage. It is worth bearing in mind throughout this development step that no solution or approach is perfect and there will probably always be some criticisms of it. It is important for a single institution, group or individual to have an overview of the indicator development process or project as a whole and to be able to make a final decision about which indicator or approach will be selected.

Questions to ask during this step:

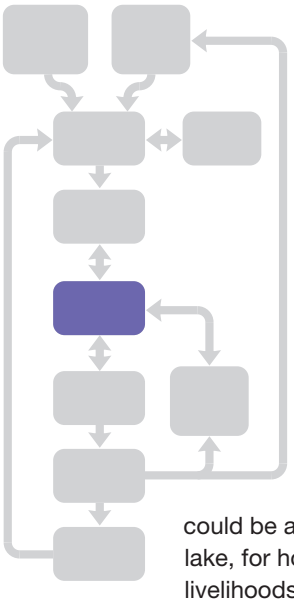
- *Are there existing indicators that can help to answer the key question(s)?*
- *How well does each of the potential indicators help to answer the key question(s)?*
- *Is the relationship between the measure used as an indicator and the indicator's purpose scientifically supported and easy for the user to understand?*
- *Are potential reasons for change in the value of the indicator well understood?*
- *How easily will it be understood by the intended users?*
- *Is there suitable data for each of the possible indicators?*
- *Can existing data be transformed into appropriate indicators?*
- *What are the resources available now and in the future for producing the possible indicators?*
- *Who will decide which indicators will be calculated?*

"There will always be critics, but if they can't suggest a better way of doing it that is actually practically possible, don't take them too seriously"

Jessica Grobler, SANBI

Gather and review data

Some relevant data are usually available, but need to be reviewed for their suitability



Since the production of indicators is dependent on data this step is likely to be conducted with the step "identify possible indicators". Data searches will be guided by the key questions and possible indicators. Each potentially useful dataset will need to be reviewed to determine their suitability. For example, if an indicator is required to indicate change, the data should be collected with a sufficient frequency and using a method appropriate to give the necessary sensitivity to change. The review process could also include standardising the data to common units and scales, and ensuring that the methods used to collect it are comparable. Such a review should ideally be carried out periodically to maintain the quality and consistency of the data. Consistency is essential, not only between datasets, but between years in the same dataset, so that valid comparisons can be made between different points in time.

Relevant data for biodiversity indicators can be found in many different forms, including spatially mapped data (often in the form of digital geographic information systems (GIS)), downloadable databases, statistical compendia, survey results or embedded within online documents or books. Data in different formats may need to be combined before they are analysed, and if data are from a range of sources this may be both challenging and time consuming. Designing a common format or series of databases to store the data at the start of the project can help to solve this problem, so that data can be added to it as it is collected. If data are gathered from multiple sources, a rigorous referencing system is essential to be able to keep track of data sources and be able to refer back to the original source data if needed. If multiple institutions are collecting data, this process needs to be standardised across all of the institutions.

Look for data in other sectors

Lack of suitable data is widely identified as a major constraint to the production of biodiversity indicators. Whilst this is undoubtedly the case, it is worth considering that many aspects of biodiversity conservation and sustainable use overlap with other sectors that depend on or affect the natural environment, such as farming, forestry, fishing, outdoor recreation, tourism and infrastructure development. Such sectors are likely to have policy-making and management procedures that produce information that either directly impacts biodiversity, or can help to answer aspects of key questions. For example, fish catch statistics from Lake Victoria in Uganda could be an indicator for the quality of the water in the lake, for how dependent people are on fisheries for their livelihoods, for whether the lake's resources are being used sustainably, or for how the introduced Nile perch (Lates niloticus) may be affecting the ecosystem. Such indicators not only have the advantage of using already existing information, they can also help to develop cross-sectoral interactions and awareness of issues related to biodiversity. It may also be possible to make use of existing expertise and experience in the field to generate information for building indicators. This is especially true where systematic "field" data are lacking but researchers and managers have large amounts of accumulated experience of the ecosystems and species of interest. For example, indicator developers within the government of Ukraine asked a body of experts to estimate population levels of species in the agricultural landscape relative to a fixed baseline, and were able to combine the resulting data into a single species trend index. While it is important to track the uncertainty in these kinds of data, such "soft" or qualitative approaches have the additional advantage of preserving knowledge that is often unrecorded in any formal sense and which may disappear as individuals change jobs.

"One of the biggest challenges to date has been securing the data needed in formats that facilitate the development of the indicator or index. It involves developing close relationships with multiple researchers and organisations and continual communication to develop a trusting relationship"

Mike Gill, CBMP

Questions to ask during this step:

- *How does the available data relate to the key questions and possible indicators?*
- *Is the data for an appropriate time period and geographical area for the users' needs?*
- *Are the data accessible and likely to continue to be produced in the future?*
- *Are the data collected in a consistent and comparable manner over time?*
- *If an indicator is required to detect change, are the data collected with sufficient frequency, or is the data collection method appropriate to give the desired sensitivity to change?*
- *Are the necessary agreements in place to allow the data to be collected and used?*

"Focus on making sure that your indicators can be repeated over and over again to build a time series"

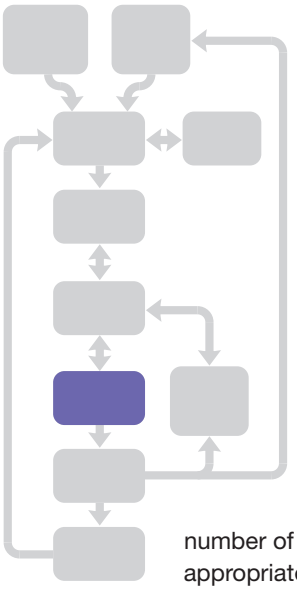
Jessica Grobler, SANBI

Collaborations and agreements to support indicator development

Part of the key to successful indicator collaborations is managing the expectations of all those involved, such as how and when they can input into the indicator and what the outputs will be. If the collaboration involves the exchange or use of data it is essential that all partners are clear and agree on how, where and why the data will be used. This can be agreed upon informally in meetings. However, in the experience of UNEP-WCMC and many national indicator partners, written agreements in the form of terms of reference, data sharing agreements, letters of agreement or even e-mails are very useful. Such documentation states the expectations of the partners and is a reference point if there are any questions later. Data sharing agreements can also contain clauses to limit how the data will be used, how it should be acknowledged and whether any outputs need to be reviewed by other parties. The larger the number of partners involved in indicator development the greater the need for such formalised agreements and governance structures. Partners may have defined roles or form groups such as a 'user group' or a 'client group'.

Calculate indicators

Converting data into indicators is an iterative process of exploring different methods. The methods used should be documented.



Indicator calculation is an iterative process

The actual calculation of indicators through the use and presentation of data is an iterative process to explore different methods and find the most suitable ones. Since this is an iterative and creative process, in many ways this step overlaps with the previous ones to identify possible indicators and review the data, as well as the communication of indicators.

The starting point for calculating an indicator is the key question that is being addressed, the definition of the use of the indicator, and the conceptual model of the issue. An example key question could be, “Are we effectively conserving the wildlife in our protected areas?” For this example, the indicator will be used in annual reports by the national wildlife agency to the Ministers for environment and tourism. The data available are annual surveys of large mammals for most protected areas for most years in the period 1963 to 2008.

A key part of indicator calculation is to understand the data, such as their strengths, their limitations, and where they have come from. In this example, the data is not for all wildlife but just for large mammals and this could be accepted as sufficient for the desired purpose. The data collection methods should be examined to see if they are total counts or samples, and what are the confidence limits on the results. Another question could be if there are sufficient counts of all species for all of them to be included in the indicator(s)?

Once the strengths and limitations of the data have been assessed then ways of calculating the indicator(s) can be tried. A simple method may be to produce a bar chart of the total number of animals counted per year. It may well be more appropriate to also present bar charts for individual species over time, and for individual protected areas. This may help to identify different trends that are lost in the overall aggregation of data. Alternatively, the combined population counts could be converted into a moving average figure of say five-yearly periods if the survey methods are appropriate for this, to help identify any changes. The indicator calculation could use a method to produce an index value, such as the Living Planet Index method. Other ways that the data could be reworked to help answer the key question might be to convert animal numbers to biomass, or to subdivide the data into herbivores and predators.

Different indicator calculation methods are likely to vary in their validity as a scientifically-based indicator of the issue of concern, as well as the statistical validity of the use of the data. This is one reason why indicator development is best done as an iterative process, to identify the most appropriate method.

The initial calculation of an indicator may indicate some significant changes in the issue of interest, such as population declines, but the indicator by itself doesn't explain why this situation is observed. With the aid of the conceptual model, and perhaps in consultation with the data providers, further questions and hypotheses could be explored to interpret the changes. Other data sets and indicators could complement this examination of the issue, such as declines of large mammals in relation to hunting pressure, habitat change, annual rainfall, or food availability.

The methods used should be documented

The calculation of an indicator must be accompanied by documentation of the methods used and data sources. This ensures that the calculation is transparent and open to scrutiny and can be repeated in the future for consistent production of the indicator.

Potentially suitable data may often require some form of editing or transformation to make it suitable for the selected indicator calculation method. For example, data points from various sources may need reworking into certain time periods, or formatting for analysis using a GIS.

Whatever methods are used it is of fundamental importance that they are scientifically defensible, particularly as many issues related to biodiversity are contentious and may involve disputes between different interest groups. Indicators that are pressed into service in such conflicts are likely to be subjected to close scrutiny. In general, procedures used in indicator generation must be transparent and testable, sources of data verifiable and any potential weaknesses or biases acknowledged.

The **Indicator Fact Sheet in Annex 1** is a very useful template for documenting the methods for calculating an indicator. An example of a completed fact sheet from Ukraine which summarises the countries' types and areas of agricultural land is in Annex 2.

Questions to ask during this step:

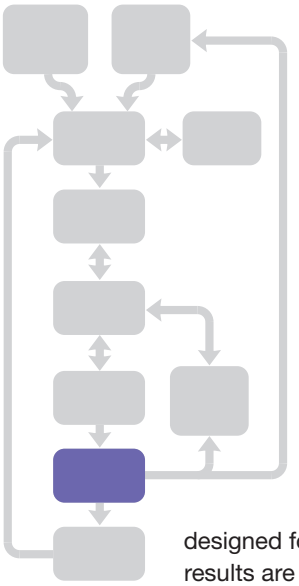
- *Are the methods of data collection and analysis scientifically valid and defensible (considering the conceptual model)?*
- *Have all the steps for calculating the indicator been documented so that someone without prior experience of the indicator can follow them?*

"Keep clear, complete records of where you obtained all data and how all the calculations were performed in a way that someone else could understand if they needed to repeat what you have done."

Jessica Grobler, SANBI

Communicate and interpret indicators

Indicators are communication tools and need investment in their presentation and explanation



In some ways indicators can be seen primarily as a communication tool to help people understand complex issues. They therefore need to be presented and interpreted appropriately for their intended audience. Several steps in the Biodiversity Indicator Development Framework can help to achieve this. For example, one of the benefits of defining a key question is that it naturally encourages the selection and communication of the indicators in a form that aids their interpretation. Usually some text accompanies the presentation of an indicator, whether it is a graph or a map, and this explanation is easier and more targeted when it is in response to a key question. The explanation may be part of the legend below a figure or within the text surrounding it. Whatever the explanation, it should include the purpose of the indicator and how to interpret any trends.

Use indicators to communicate stories

Overall, it is recommended that the communication of indicators be designed in the form of a 'story' or narrative about the subject, in response to the key question(s). The narrative surrounding an indicator is essential, as indicators by themselves provide only a partial understanding (indication) of an issue. They always need some analysis and interpretation of why they are changing and how those changes relate to the system or issue as a whole. Additional information allows the reader to put the indicator in context and see how it relates to other issues and areas. Information to support and explain the indicator should therefore be collected as the indicator is developed.

Creative thinking is needed in developing methods for presenting data to non-specialists or those outside the immediate subject field of the indicator. Scientists and technicians used to dealing with large amounts of complex data may find it hard to understand the problems that non-specialists have in dealing with and understanding such data. For example, although complex graphs and densely packed tables with figures to four decimal places can be appropriate for a scientific journal, for non-scientists this may be incomprehensible and even alienating.

Simplify indicator messages

It is often necessary to simplify information in order to convey useful messages to a wide audience. However, the art in communicating indicators is to simplify without losing scientific credibility. This requires a thorough understanding of the concepts being dealt with and knowledge of the boundaries and limitations of the data and how they can be interpreted.

The skills needed for indicator development are not solely in technical areas but also in communication and writing. However, under some circumstances it may be beneficial to enlist external help or expertise in how best to present the indicator. An indicator may be designed for only one audience or user, so the way the results are portrayed and explained can be very much tailored to their information needs and background. It may also be that the results will be communicated to many different audiences, for example policy makers, scientists, businesses and the news media. This presents a challenge for those who communicate the indicator, as they have to choose between producing a single report which will provide general information for all readers, or multiple products tailored to different audiences.

"I have learnt that developing key messages from your indicators or indices is crucial and that you need to consult widely with the data providers to ensure that you get the messaging right and that it's not in conflict with individual datasets."

Mike Gill, CBMP

"The success of an indicator initiative can be determined by its communication strategy. We have paid special attention in design of the indicators fact sheets and the communication tools to reach the public."

Cesar Rodriguez-Ortega. General Direction for Environmental Information and Statistics, Ministry of the Environment and Natural Resources of Mexico.

Examples of good and poor communication of indicators can be found in many reports about biodiversity and the environment, and it is worth studying this aspect of different reports. Participants in 2010 BIP regional biodiversity indicator capacity building workshops have identified the following:

The target audience [for the indicators we produce] is mainly an informed, interested public. Although accessible to the general public, the focus to-date has been on those within and outside government with a professional / technical / research interest in biodiversity.

Ed Mackey, Scottish Natural Heritage (SNH)

"Keep it simple – try not to have too many indicators, or the audience will be confused by conflicting messages"

James Williams, JNCC

Questions to ask during this step:

Target audience

- *Who is the target audience?*
- *Is there more than one target audience?*
- *Why are they being targeted?*
- *How familiar with the subject is the audience?*

Strengthening how the messages are communicated

- *What other information is available for the indicator subject?*
- *What medium will be used to communicate from indicator? Will there be a printed report, a document on a website, a static or interactive web-page, or a short summary within a larger chapter or report?*

Ten lessons learnt from communicating and presenting indicators:

1. Indicators should target a particular audience and the way the indicator is presented depends on this audience.
- For example a complex scientifically presented indicator may not be suitable for a lay or policy maker audience.

2. The level of information in the indicator must be appropriate to the question you want to answer.
- This level may be global, national or local, depending on how the indicator is going to be used.

3. Simplifying the information within the indicator is key to conveying a clear message.

4. An indicator does not necessarily have to show continuous change through time.
- Maps and other spatial data can be a very useful way to communicate a message
- Maps can present multiple snapshots over time, for example to show priority areas

5. Combining or including too many types of information within a single indicator makes it hard to interpret.
- If there are a number of different types of data, then a number of figures can then be used together to convey the message.

6. Categories and symbols used within the indicator must be clear and well defined, either as part of the figure or in the figure legend.

7. Use of colour is very helpful in being able to convey the messages clearly.
- Contrasting colours should be used and combinations of red/green should be avoided because some people have colour-blindness.
- Graded colours can be very effective in showing trends on maps or differences between areas, but they should be clearly explained and easy to interpret.

8. Comparisons between timepoints or conditions must be clear.

9. The presentation of an indicator should clearly state the purpose of the indicator and how to interpret on the figure and in the accompanying text.

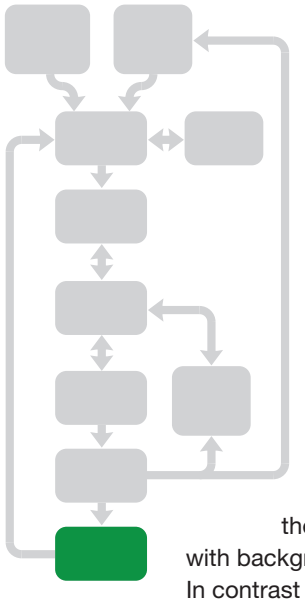
10. Often a single indicator is not enough to tell a full story.
- Additional information is often needed and should be chosen carefully with both the key messages and the primary audience in mind.

Test and refine the indicators with stakeholders

Check that the indicators are understood by the intended users and are useful

In the experience of UNEP-WCMC and its partners, a key step in the production of successful biodiversity indicators is to test and refine the indicators with the stakeholders who will use them. For indicators which involve the development of new methods or new combinations of datasets this testing and refining is a central part of indicator development.

The presentation of draft or preliminary indicators is useful for both indicator developers and stakeholders. For stakeholders, it allows them to see how the indicator is progressing, whether it answers their questions and how it might be used in decision making. Those producing and presenting the indicators should be ready to make changes in response to this feedback. This consultation should therefore be regarded as an ongoing, iterative process.



"[One of the biggest achievements of the SEBI 2010 indicator initiative] is the fact that the work is acknowledged by high level decision makers and political levels"

Frederik Schutyser, European Environment Agency (EEA)

Stakeholder expectations may need to be balanced

If the development of the indicator involves a number of stakeholders, each may have differing expectations of the degree to which they are expected to be involved in ongoing review of the indicator. For example, during the development of wetland biodiversity indicators in Kenya, four categories of stakeholder had distinct expectations of their involvement. Local wetland communities and resource users were mainly interested in just the resulting indicators and interpretation of the issues, to empower them in decision making and resource use. Policy makers and regulators were also primarily interested in the end results of the process as it provided them with background information on the state of the resource. In contrast government wetland management and research institutions, who were actively involved in the indicator development process, used it to build their own capacity and understanding. Non-governmental organizations were also often interested in the process as much as in the end-product, seeing it as a possible way of enhancing the participation of the wider community in decision making.

The opinions, or needs, of stakeholder organisations may differ and there are practical limits to the extent to which indicator developers can make changes to accommodate all their needs. It is important for the organisation or group leading the development of the indicator to manage these expectations, and to co-ordinate the review of the indicator in such a way so that stakeholders provide appropriate input and review it in constructive and positive way.

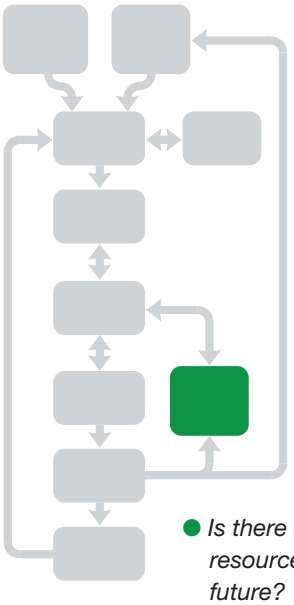
Questions to ask during this step:

- *Does the indicator answer the users' key question(s)?*
- *Is the indicator fit for purpose?*
- *Is the indicator understood in the intended manner by the users?*
- *What improvements could be made to the indicator and its presentation?*

Develop monitoring and reporting systems

Monitoring provides consistent data over time and a reporting system enables regular production of the indicator(s)

A lack of suitable data, especially data with comparable time series, is often given as a reason preventing the production of biodiversity indicators. If valuable biodiversity indicators are identified and chosen for use over time then an investment is required in the monitoring systems to produce trustworthy and accessible data.



The ongoing production and reporting of biodiversity indicators also requires establishing the institutional and technical capacity for this work. This capacity may not exist within a single agency, and may involve both NGOs and government agencies working in partnerships to generate indicators. The need for capacity may not solely be in scientific analysis but also in such areas as communication and writing skills. Therefore, teams with diverse backgrounds and training may be most effective in generating and communicating indicators.

Indicator factsheets can aid the inclusion of consistent data

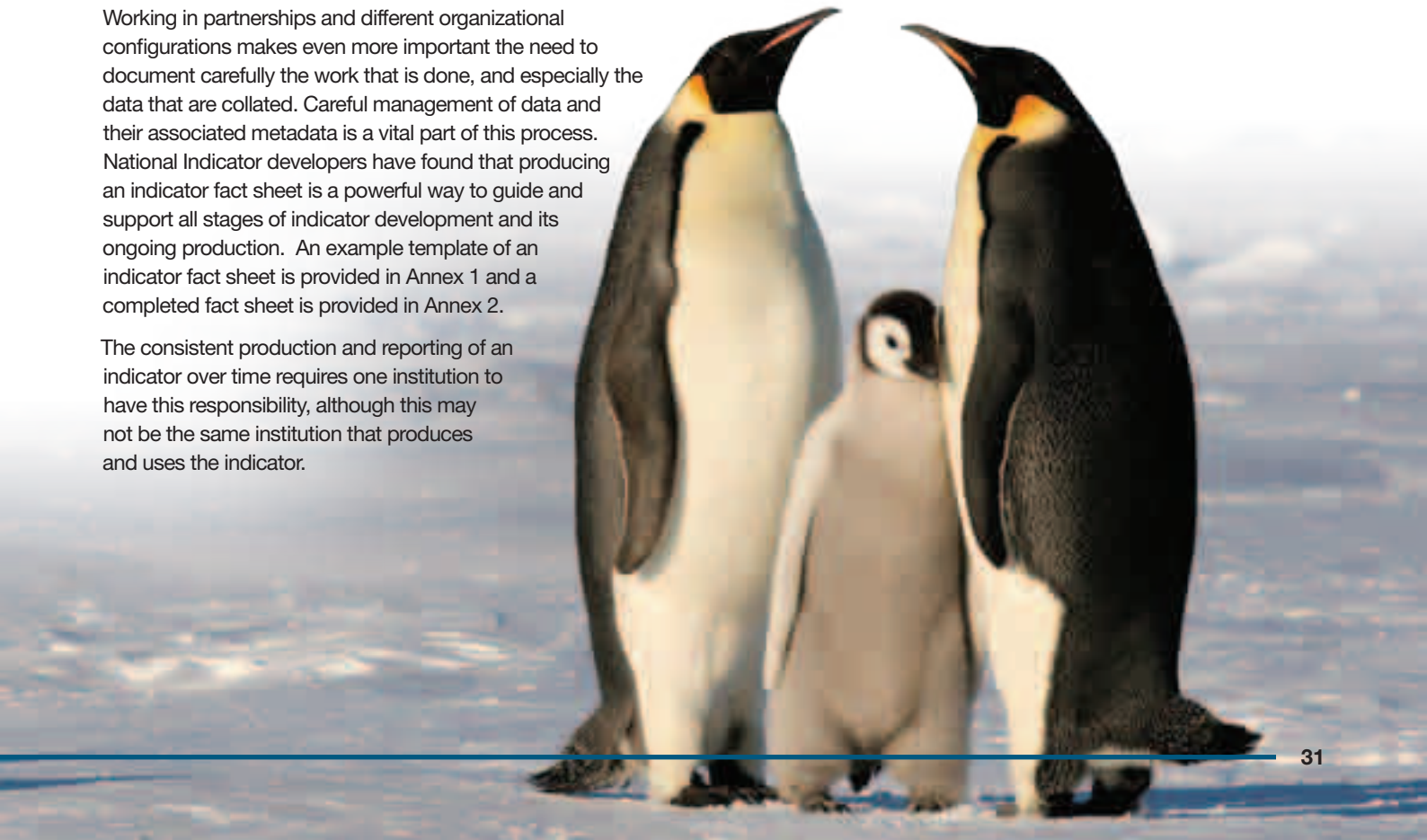
Working in partnerships and different organizational configurations makes even more important the need to document carefully the work that is done, and especially the data that are collated. Careful management of data and their associated metadata is a vital part of this process. National Indicator developers have found that producing an indicator fact sheet is a powerful way to guide and support all stages of indicator development and its ongoing production. An example template of an indicator fact sheet is provided in Annex 1 and a completed fact sheet is provided in Annex 2.

The consistent production and reporting of an indicator over time requires one institution to have this responsibility, although this may not be the same institution that produces and uses the indicator.

One way to promote the sustainable production of an indicator is for it to be recognised and adopted by a national statistical agency. This endorsement and demand for its regular calculation provides a strong case for the necessary long-term investment of resources. This investment must include the maintenance of a monitoring system to produce reliable data over time. Also, the more an indicator meets a real decision-making need and it is effectively communicated then the greater the likelihood that resources will be found for its continued production.

Questions to ask during this step:

- *Is there sufficient institutional technical capacity and resources to produce the indicator now and in the future?*
- *Is there a clear institutional responsibility for the continued production and reporting of the indicator?*
- *Do data collection and monitoring systems or agreements need to be strengthened?*



Annex 1: Indicator Development Fact Sheet: outline

Indicator Name:

Lead Agency:
institution & person responsible for calculating and communicating the indicator.

Use and interpretation:
Key question(s) which the indicator helps to answer
Users of the indicator
Scale of appropriate use

Potential for aggregation:
Meaning of upward or downward trends ("good or bad")

Possible reasons for upward or downward trends:

Implications for biodiversity management of change in the indicator:

Units in which it is expressed:
(e.g. km^2, number of individuals, % change)

Description of source data:
(origins, dates, units, sample size and extent, custodians)

Calculation procedure:
(include appropriate methods and constraints for aggregation):

Most effective forms of presentation:
(graph types, maps, narratives, etc. – give examples where possible):

Limits to usefulness and accuracy:
(e.g. slow change in response to pressures, poor quality data, limited scope for updating)

Updating the indicator:
(how often? What is the process?)

Closely related indicators

Additional information and comments

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Annex 2 – Indicator Development Fact Sheet: completed example

This fact sheet has been provided by the Ukraine Land and Resource Management Centre (ULRMC) and was produced as part of the UNEP-GEF project 'Biodiversity Indicators for National Use' in 2005.

Indicator Name — Types and areas of agricultural lands

Lead Agency: **ULRMC**

Use and interpretation

Central bodies of state executive power of Ukraine and their local authorities, including the beneficiary and the recipients of the UNEP-GEF Biodiversity Indicators for National Use (BINU) Project, and other users.

Key questions

The indicator helps to answer two key questions: *"What is the current state of agricultural biodiversity in Ukraine?"* - as it concerns the size and extent of the surface of the agro-landscape (agro-sphere) or habitats; *"What are the main factors that cause agricultural biodiversity loss or increase, and how do changes in the land use practices influence upon agricultural biodiversity loss or increase?"* This indicator is referred to the group of indicators of driving forces (D) and state (S), and should be considered together with data on biodiversity.

Scale of appropriate use and potential for aggregation

The entire territory of Ukraine. At the same time, the existing practice and reporting allow for making calculations in the section of administrative oblasts and districts. Therefore, the indicator is compatible with indicators of the same scale, for example, the indicator of changes in the land use, the area of irrigated and drained lands, fractions of disturbed lands in the land of the country, etc. It is important that data used while calculating this indicator can also be used while calculating the *Natural Capital Index (NCI)* [1] and other significant indicators, for example, the indicator of human resources and energy costs per unit of area or category of lands. Actually, the given name of the indicator implies a number of indicators (table 1, fig. 1) which have great potential for aggregation: *Area of Arable Lands Per Capita, Protected Agricultural Areas (Agricultural Areas Inside of Protected Areas), Hunting Areas Inside of Agricultural Lands, etc.*[1] It is also recalculated into the indicators of the land use optimization (see below).

Possible reasons for upward or downward trends

Within the state statistical reporting this is a set of different indicators. The indicator is determined annually. It is very important for monitoring the state of agro-ecosystems of Ukraine. In fact, we are talking about such important surfaces (including flora and fauna habitats) as agricultural lands, arable lands, pastures, haylands, forests and forest-covered areas which could also be considered as mono-indicators. These data allow finding out to what extent *the agricultural area is cultivated* (table 1). In general, in Ukraine it is observed **a decrease in percentage of intensively farmed agricultural areas** as well as agricultural lands as a whole, which is connected with implementation of a set of sustainability programs. Theoretically, decrease in agricultural areas being cultivated should have a positive impact upon biodiversity of many wildlife species.

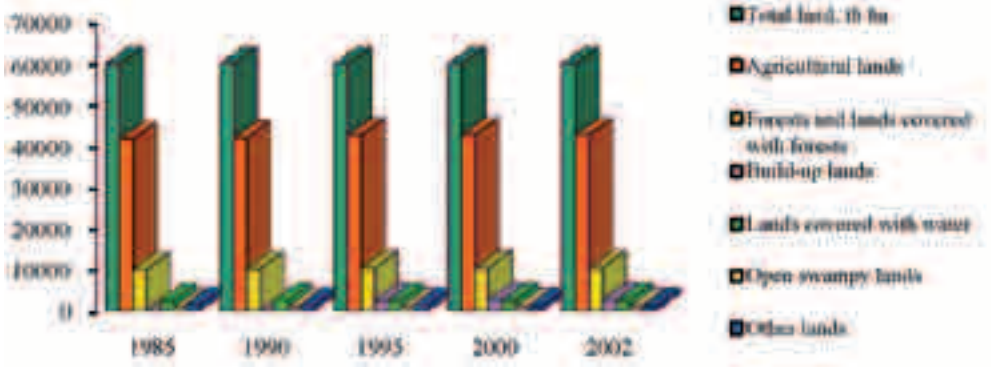
Implications for biodiversity management of change in the indicator

The indicator is traditionally described in annual state-of-the-environment reports in Ukraine, however, there has not been developed an algorithm of transforming it into biodiversity indicator. Henceforth, it will also be taken into consideration while implementing the Concept for Perspectives of Use, Conservation and Reproduction of Agrobiodiversity in Ukraine. The indicator is related to the suggestion on land optimisation in Ukraine (fig. 2). The main provisions of this Concept were published in 2003 [2]. The given indicator is not included into the list compiled on the basis of the survey results of the countries-participants of the Convention on Biological Diversity, which was conducted by the Subsidiary Body on Scientific-Technical and Technological Assistance (SBSTTA) [3], however, it is critical for Ukraine. For example, at the same time, 43 countries-participants of the Convention have included the indicator *Agricultural Areas (intensively farmed, semi-intensively farmed and uncultivated)* into the above-mentioned list, and the given indicator *(Types and Areas of Agricultural Lands)* can be used to work with it. The participants of the BINU workshops, held in 2002-2004, adopted that the indicator *Types and Areas of Agricultural Lands* is critical.

Units in which it is expressed *(for example, km², number of individuals, % change)*
In the annual statistical reporting such units as thousand hectares *(th ha)*, percentages of the total area (%), etc. are used to express different indicators.

Description of source data: *(origins, dates, units, sample size and extent, custodians)*
The indicator is determined on the basis of the state reporting statistics by Form 6-зем (Report on land availability and its distribution by land owners, land users, types of land and economy- Ukr) and Form 2-тп (i.e. reclamation). These forms are annually collected and processed by the State Land Committee of Ukraine and the State Statistics Committee of Ukraine.

Figure 1 Dynamics and distribution of land resources in Ukraine (as of January 1st, 2003) Source of information: State Statistics Committee of Ukraine



Calculation procedure *(inc. appropriate methods and constraints for aggregation)*
The process of calculation at the local level is performed according to the requirements on how to fill in Form 6-зем *(Report on land availability and its distribution by land owners, land users, types of land and economy- Ukr)* and Form 2-тп *(reclamation)*. The methodology for calculating of the total area of agricultural lands and cultivation of agricultural areas (table 1) is the following [5]:

$O_c = S_{c\_y} / (S_{кр} - S_в) * 100$, *where*

O_c - cultivation of agricultural areas, %;
S_{c_y} - area of agricultural lands, th ha;
$S_{кр}$ - total land area, th ha;
$S_в$ - inner waters, th ha.

Theoretically, there are constraints for aggregation with indicators concerning the representation of different categories of lands in natural zones. This is due to the fact that borders of natural zones and administrative units, on which statistics is traditionally based, do not coincide.

Most effective forms of presentation *(graph types, maps, narratives, etc. - give examples if possible)*
As of January 1st, 2003, the total area of the land of the country amounted to 60354.8 th ha, the area of inner waters - 2421 th ha, the area of agricultural lands – 41800.4 th ha, and the area of agricultural lands being cultivated totaled 72.2% - table 1, fig. 1. There is a tendency towards increase in the areas covered with forest, decrease in cultivation of agricultural lands and build-ups (table 1, fig. 1, Annex 1), which influences upon biodiversity of agro-landscapes (see below). Besides tables and figures, we suggest using a more modern form of presenting results - this is a thematic map (Annex 1). The sample was developed with the help of GIS. While implementing the BINU Project there was also demonstrated the perspective use of remote sensing of the Earth data to explain research statistics [6] and map changes in animal habitats because of changes in the land use practices [8].

Table 1: Sample: data used to calculate the area of cultivation of agricultural lands (as of Jan 1st, 2003): Source of information: State Statistics Committee of Ukraine, UNEP-GEF BINU

Indicators	1985	1990	1995	2000	2002
Total area of the land of the country, th ha	60354,8	60354,8	60354,8	60354,8	60354,8
Area of inner waters, th ha	2403,3	2435,1	2403,3	2423,5	2421,0
Area of agricultural lands, th ha	42402,0	42030,3	41852,9	41827,0	41800,4
Area of cultivation of agricultural lands, %	73,2	72,6	72,2	72,2	72,2

Data source and process for updating

Form 6-зем *(Report on land availability and its distribution by land owners, land users, types of land and economy- Ukr)*. Archives and annual statistics can also be accessed on the official web site of the State Statistics Committee of Ukraine [4].

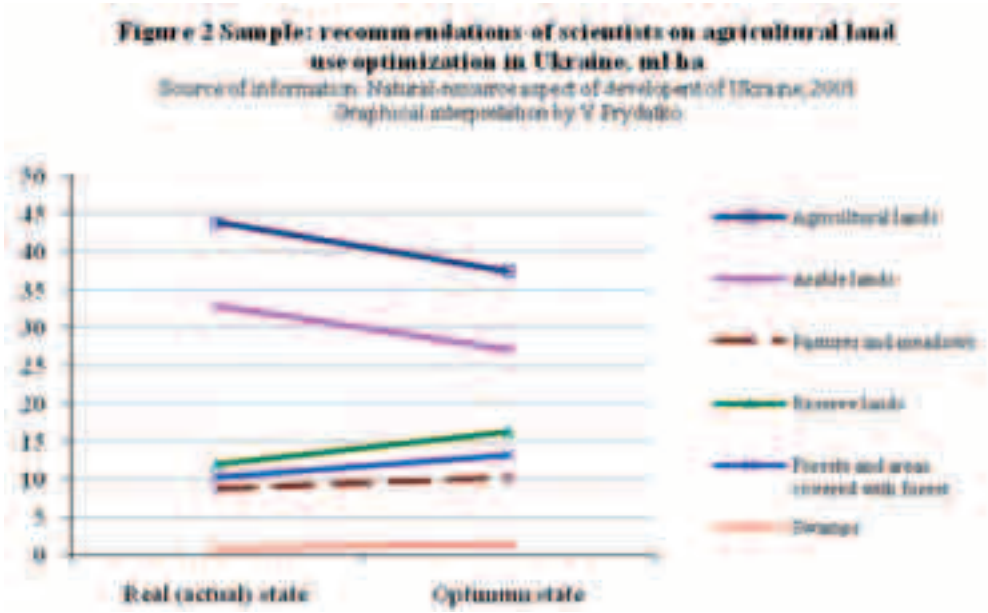
Closely related indicators

Besides the above-mentioned indicators, there are also important indicators considered by the BINU Project, such as (1) *Anthropogenic Pressure: the Red Data Book Species Response to Anthropogenic Pressure (or RDB-index)*, and (2) *Areas of High Diversity with Threatened Species*.

Additional information and important comments

In the result of materials study on remote sensing - Terra MODIS 2000, and GIS-analysis, performed by ULRMC, it has become possible to show: (a) highly mosaic surface of agro-landscapes (agrosphere) - these are territories where phototonus of the surface constantly changes - and the surface of other landscapes (non-agrosphere) - these are territories where phototonus changes less actively [6]. A calculated fraction of agro-landscapes surface constituted 64% of the total surface of Ukraine.[2] Official data reported a different percentage (72.2%), which could be explained not only by the error of the research method but also by the fact that more lands are uncultivated.

Recently Ukrainian scientists have developed general recommendations as to land optimization in Ukraine, including agricultural lands (fig. 2).



It is necessary to note that these recommendations require further appropriate mapping support and additional research in order to receive more generalizations. As it was shown on the example of birds of the Kyiv agglomeration, in order to monitor biodiversity changes it is not enough to plan the changes of areas of different categories of lands but to take into account their dimensions (geometry), mosaic peculiarities and space context as well [8]. Quantitative and qualitative indicators of ornithological fauna have also undergone changes due to decrease in the total extent of forest belts and their average length, and breaking up of the elements of agro-landscape mosaic. First of all, these pressures had impact upon birds of open landscapes, in particular on larks (Alauda arvensis Linnaeus, 1758; Galerida cristata Linnaeus, 1758). Here it is observed a balance of forces: when geometry of different categories of lands changes, some species are in better conditions, others are in worse ones.

Additional sources of information

Біорізноманіття: скільки його залишилось? Особливості Індексу природного капіталу (ІПК) [Natural Capital Index (NCI)] - http://www.ulrmc.org.ua/services/binu/prmaterials/nci_flyer_ua.pdf.

Перспективи використання, збереження та відтворення агробіорізноманіття в Україні. (Відповідальні редактори академік УААН, проф. Патика В.П., д.б.н., проф. Соломаха В.А.). Київ: “Хімджест”, 2003, 254 с.

Indicators and Environmental Impact Assessment. UNEP/CBD/SBSTTA/7/12, September 20, 2001, p.21.

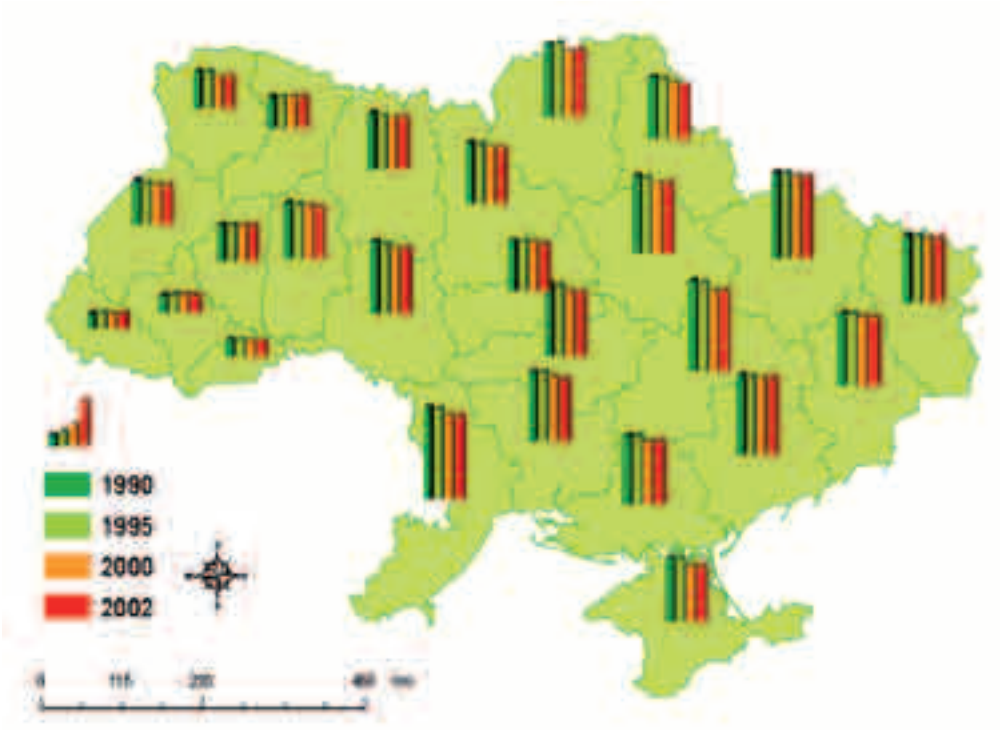
Офіційний сайт Держкомстат України / Річна статистична інформація/ Сільське господарство - http://www.ukrstat.gov.ua/

Поточні результати пошуку та тестування індикаторів біорізноманіття/агробіорізноманіття та приклади їх використання в Україні (пояснювальна записка) – додаток до листа УЦМЗР №848/2 від 29.01.2004, переданого в Держкомстат України.

Созинов А.А., Штепа Ю.Н, Придатко В.И. Агросфера как объект целевого исследования с помощью ДЗЗ и ГИС для улучшения управления территориальным развитием и сохранения природного биоразнообразия/ Ученые записки Таврического национального университета им. В.И.Вернадского. Т.17 (26), №2.–С.72-85.

Природно-ресурсний аспект розвитку України / Проект «Програма сприяння сталому розвитку України». (Керівники розділів: І.Андрієвський, Ю.Шеляг-Сосонко). Київ: Видавничий дім "КМ Academia", 2001, 107 С.

Thematic map: area change of agricultural lands in Ukraine (1990-2002)



Source of statistics: State Statistics Committee of Ukraine. Administrative borders are displayed using a digital map of a scale of 1:500 000, developed by the Inter-departmental Center of Digital Mapping of the Ministry of Extraordinary Situations of Ukraine (1998).

Authors of the thematic map: A. Ischuk and V. Prydatko, ULRMC. UNEP-GEF BINU Project, 2004.

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Last updated Jan 27, 2005
More details can be found at the web site http://www.ulrmc.org.ua/services/binu/index.html

The assessments and opinions of the author(s) do not always coincide with the official point of view of the Ministry of Environmental Resources of Ukraine, the Secretariat of Convention, UNEP, GEF, and other donors and implementing agencies

Guidance for National Biodiversity Indicator Development and Use

This document is designed to help with the development of biodiversity indicators at the national level for uses such as reporting, policy-making, environmental management, and education. It is intended for potential biodiversity indicator developers, whether they are in government agencies, academia or NGOs.

The guidance is presented in two sections:

The first defines what an indicator is and examines the multiple uses of biodiversity indicators.

The second explains a series of steps in successful indicator development.

For more information on national biodiversity indicator development visit
www.bipnational.net

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Biodiversity Indicators Partnership

UNEP WCMC

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