CONABIO

TWO DECADES OF HISTORY

1992 • 2012

SYNTHESIS

NATIONAL COMMISSION FOR THE KNOWLEDGE AND USE OF BIODIVERSITY
MEXICO, 2012

Presentation

Mexico is a country with an exceptional biological diversity, expressed in diverse ecosystems where a myriad species - many of them endemic- coexist, possessing a broad genetic variability as well as a rich cultural mosaic, manifested not merely by the almost 300 languages still spoken, but more particularly by the interaction between such cultural diversity and the biodiversity, exemplified by the fact that Mexico is one of the centers of domestication of plants cultivated worldwide.

In March of 1992, three months prior to the celebration of the United Nations Conference on Environment and Development -the Earth Summit- in Rio de Janeiro, the National Commission for the Knowledge and Use of Biodiversity of Mexico (CONABIO, by its Spanish acronym) was established by a presidential decree. CONABIO was created as a permanent Interministerial Commission with the mission of coordinating and promoting activities related to the knowledge and sustainable use of the biodiversity of Mexico.

CONABIO

The National Commission is headed by the President of the Republic and is currently composed by the heads of the Ministries of: Environment and Natural Resources (SEMARNAT); Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA); Social Development (SEDESOL); Economy (SE); Education (SEP); Energy (SENER); Finance and Treasury (SHCP); Foreign Affairs (SRE); Health (SS) and Tourism (SECTUR). The Minister of SEMARNAT, serves *ex officio* as technical secretary of the Commission. CONABIO performs its role via a task force composed of specialists in a broad variety of fields, led by a national coordinator.

Some 60-70% of CONABIO's budget comes from federal funds; the remainder originates from external sources, some of which are of international origin. All funds are deposited in a private trust, an arrangement that has played a fundamental role along the years in the performance of the Commission by enabling a smooth, efficient and transparent use of the resources available to it.

CONABIO was given the legal responsibility to implement and operate the National Biodiversity Information System (SNIB). CONABIO conducts applied research to solve specific problems, promoting and supporting fundamental research in universities and research institutions; about 50% of its annual budget is allocated to support such research. Since its inception, CONABIO has acted as a bridge between the governmental sector and academia, especially those experts and scientists who generate applicable knowledge and information to the solution of field problems. CONABIO also acts as a laboratory in the field for the promotion of cross-sectorial public policies relating to the use of natural resources.

CONABIO assumed from the beginning a responsibility for making the results of its work accessible to all members of society, while respecting intellectual property rights. Two principles underpin this philosophy: first, virtually all of the information utilized by CONABIO originates in public institutions funded with public moneys and therefore should be accessible to all society; and second, the conviction that only with a well-informed and aware society it is possible to develop and strengthen a culture of appreciation and valoration of the natural capital of Mexico.

To better understand the work carried out by CONABIO over the last twenty years one could say that, broadly speaking, the Commission has set itself to the task of *obtaining information with which to carry out analysis and study of the biodiversity of Mexico that generates knowledge and therefore enables informed decision-making regarding the use and conservation of that biodiversity*. In practical terms, this has meant for the Commission the acquisition and systemization of data –relative to the ecosystems of Mexico and to the plants, animals and microorganisms that live in them- the creation of a reliable information system and, from this, the establishment of a solid infrastructure with which to advance in the generation of knowledge regarding the nature of Mexico, and its conservation and sustainable management.

The task of CONABIO was first and foremost to *obtain, select, enhance and systematize data*; however, the next big step has been the development of methodologies with which to analyze and refine information, the use of data to develop models of species distribution, and the monitoring of changes in ecosystems and the generation of knowledge and understanding of the processes that occur naturally within ecosystems, as well as changes such as structural modification, that occur as a result of human action.

The experience CONABIO has acquired over time has allowed it to participate, supported by sound information, in the generation of environmental laws (e.g. those related to genetically modified organisms or environmental impact assessment) and in the development of public policies that reflect a vision of sustainable use (conservation planning, scientific collection, access to genetic resources, invasive species, among other examples); it has also contributed to the raising of public awareness in terms of the value of natural wealth of Mexico and the need for its long term conservation

The above experience is also reflected in the development of projects and programs that benefit sectors of society through the conservation, sustainable use and management of the biodiversity of Mexico, in such a way that there is a collective economic benefit for the owners of the resources, most of whom belong to the marginalized rural sectors of Mexico.

This is, in short, the modern vision of CONABIO; to embark fully upon the *generation* of intelligence for decision making in the conservation and sustainable use of the natural capital of Mexico.

1 The National Biodiversity Information System (SNIB)

Development of the SNIB

Since the creation of CONABIO, the SNIB forms the backbone of the research that takes place in the Commission and integrates information relating to over five million specimens, housed in numerous collections in Mexico and abroad. It has a wealth of cartographic information, pertaining to more than 3,000 environmental, infrastructural and socioeconomic themes, and 180,000 images taken by remote sensing (aerial and satellite imagery), continuously increasing geographic information and thousands of products[1] generated daily.

Since its inception, the SNIB had the purpose of sharing information -swiftly and effectively- with its numerous users in order to facilitate better decision-making. It was designed to handle very large volumes of information from two main sources: occurrence data -specimens and observations- and geographical data, *i.e.* digital mapping and remote sensing.

Regarding the formation of SNIB, the academic experts have been instrumental as providers of knowledge that translates into information for the System by effectively mixing different forms of processing through the classical paradigm: from data to information and from there to knowledge and, not infrequently, returning from knowledge to information and data.

The characteristics of the System (developed partly from the ideas of Stair *et al.* 2008) are: 1) accessibility, 2) transparency, 3) interoperability, 4) relevance, 5) reliability and 6) verifiability.

The SNIB has had, *grosso modo*, three important phases in its development, which broadly correspond to those of the institution itself: the first (1992-1996), was characterized by the support given by CONABIO to the experts to build databases, mainly of the specimens housed in biological collections nationwide. During this stage, the creation of the information system *Biótica*© was of great importance for the capture of specimen data, since its function is the standardization of data formats.

Inconsistencies in data from different databases and differences in classification schemes of species (for example, among the mammals) required the development of an information system that allowed the linkage and conciliation of content differences, particularly in relation to the taxonomy of species. This gave rise to what we call 'Taxonomic Authority Catalogs' (CAT), which are crucial to the activity of the SNIB. Currently, there are more than 80,000 names in these catalogs and the production of new catalogs is a constant and very important activity of the institution.

The second phase of the SNIB (1997-2006) was marked by a substantial increase in data resulting from the initiation, in 1988, of the World Biodiversity Information Network (REMIB; CONABIO 2008b)[2]. REMIB operated for years as one of the two global networks that linked data on biodiversity and, due to its robust structure, still continues to

[1] For example: 19,000 images of forest fires, 21,000 of solar radiance, 165,000 oceanic products.

[2] Soberón, J. (1999). "Linking biodiversity information resources." Trends in Ecology & Evolution 14(7): 291

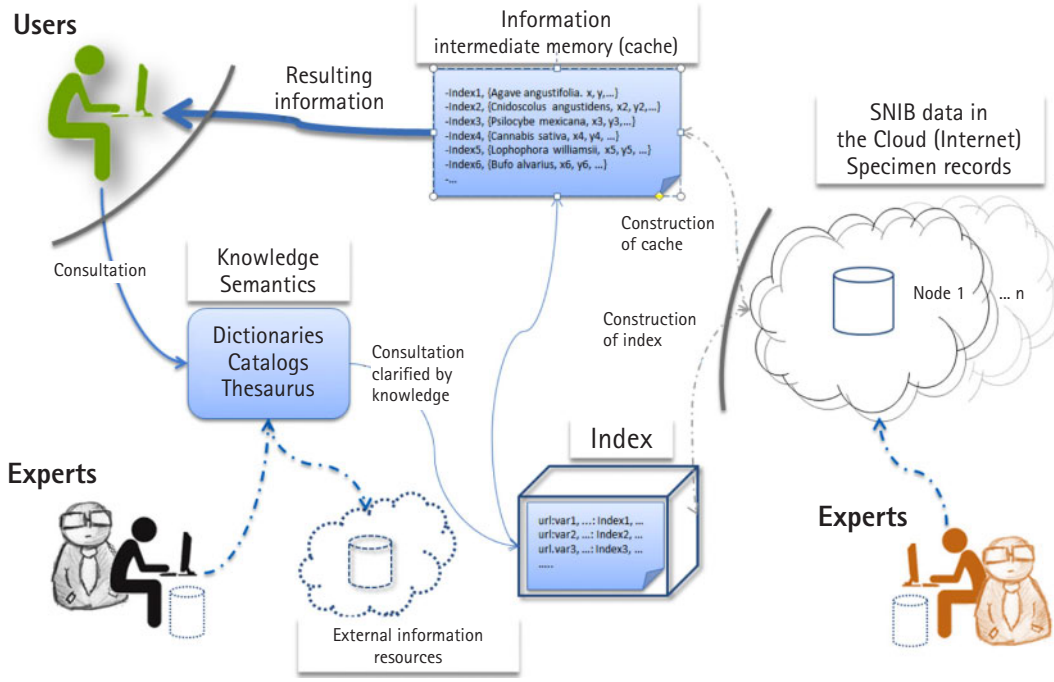

Figure 1. Diagram of the current information architecture of species as a component of the SNIB.

operate today with thousands of regular users utilizing large quantities of information every month.

Few countries were able, as intensely as Mexico during this period, to develop the capacity to translate data from fundamental research into relevant information –and to improve institutional capacities- in order to develop products useful for decision-making as well as making all the information, products and methods publicly available. The Mexican experience, among other factors, prompted the Organization for Economic Co-operation and Development (OECD) to establish the Global Biodiversity Information Facility (GBIF).

One particularly successful and innovative effort was the 'Repatriation of Information' program, created with the aim of procuring data from the Mexican specimens housed in museums and herbaria abroad. As a result of this program, around 100,000 specimen records were acquired from seven foreign scientific collections.

At this stage of the development of the SNIB, other disciplines and instruments arose within CONABIO to become a second axis of information: these included geographic information systems (represented by digital mapping of climatic, topographic, socioeconomic and vegetation variables, among others) and remote sensing.

In the third stage (from 2007 to the present) several new processes linked to the redefinition of informatics architecture were adopted. These adopted two themes into consideration: a) the species/specimen component and b) the geoinformation component, as well as the acquisition of an increased capacity to analyze, synthesize and generate data and information.

The basic informatics implemented in the REMIB were complemented by the use of recently developed architectures and technologies (as has been successfully used by Google and Amazon, among others). With regard to data integration and

retrieval of specimen information, the new SNIB architecture will provide information substantially more quickly and consistently; query responses will be generated and alternatives offered in less than a second (Fig. 1). Based on this new architecture, the Commission, following twenty years of work, is now integrating more than 600 species databases, the result of 829 projects submitted by various national and foreign institutions. These databases will be placed in what today is known as the "Cloud"

Advances in the conceptual development of geographic objects have enabled the creation of new architectures, transforming the geospatial databases, originally centered on a Geographic Information System (GIS), into relational databases. Geoinformation is currently being integrated into a geospatial database, a concept that has been used in various disciplines such as medicine (anatomical applications), electronics (integrated circuits) and biology (molecular structures). In the context of the SNIB, this database works with geometric objects that describe spatial characteristics of Earth.

In 2008, we began integrating geospatial information to the new concept of SNIB. To date, 3,094 cartographic themes have been integrated and by mid-2012, it is planned to have just over 6,000 themes. Those themes of a public nature (over 2400) are already to be found in the CONABIO geoportal[3], available for display, consultation and download.

The combination of the two themes of the SNIB -species and geoinformation- produced, by June 2011, a system of over five million specimens, fact-sheets of 1,416 species, more than 3,000 digital cartographic themes and 180,000 satellite images and aerial photos, and almost 77,000 photographs and illustrations of Mexican biodiversity. No institution in Mexico, indeed very few in the world, have a comparable body of information.

[3] http://www.conabio.gob.mx/informacion/gis/

Computerization of scientific collections

Given the importance and advantages of counting with computerized data relating to Mexican specimens, CONABIO has issued numerous calls for the digitization of scientific collections. To date, this has resulted in a total of 761 projects generating 811 databases, added to 14 donated databases and those obtained via the Repatriation of Information program, containing just over 5 million specimens (Fig 2.). There are 124 more projects in development (completion expected by March 2012) that will provide the SNIB with 770,178 additional specimen records.

Table 1. Construction phases of the SNIB

i	Integration of geographical information was conducted by so-called 'flat files' since the geometric objects were basically stored in files, in formats protected by intellectual property that did not meet international standards and could be interpreted and manipulated only with commercial software.
ii	Some data were stored in relational databases. Usually "non-spatial" attributes are stored; for example, a point representing a location could be associated, through connection to a database, with informatwion on human populations, their primary activity and other aspects. Although this method represented a great advance, it lacked the required flexibility.
iii	Integration of geographic information is conducted through "first class" geometric objects, stored directly in a relational database. Non-spatial attributes are found in the same data model. This creates improved integration, management and transparency in the administration of data, which translates into greater flexibility. For SNIB we chose the integration model proposed by the Open Geospatial Consortium *(http://www.opengeospatial.org)*

Figure 2. Prickly pear, *Opuntia auberi*, RBG Kew / CONABIO

Quality control of data in SNIB

A strict and conscientious quality control process has been applied since the beginning for data entering the SNIB. Specimen data are classified into six layers of information, each of which contains a verification process for errors, of which there can be up to forty-two types.

Seven groups of data error types have been identified: **Omission**; absence of the relevant data. **Typography** - incorrect data capture, misspellings, extraneous space, incomplete words, etc. **Context** - data that do not correspond to the definition of the field. **Redundancy** - repeated data. **Uniformity** - lack of homogeneity in the data. **Convention** - data captured without considering the conventions or standards. **Congruence** - erroneous data.

Taxonomic authority catalogs

Taxonomic Authority Catalogs (CAT) are databases that contain the scientific names of species. This information is documented with author, year of description of every name and the bibliographic citation of where the name was published, supporting the current status of each taxon. The catalogs are based on the classification systems and recent taxonomic arrangements widely used by the scientific community. They include data of synonymy, bibliographic references, distribution (state and regional) and common names. The main aim of the CAT is to control the quality of nomenclature data within the SNIB and become a nationally recognized taxonomic reference point for species.

Repatriation of Data regarding Mexican specimens in foreign scientific collections

CONABIO has obtained information on the biodiversity of Mexico through the computerization of foreign collections, through agreements and MOU's with a number of foreign institutions, which together house approximately one hundred million specimens from Mexico, i.e. ten times more than all the collections resident in the country. Much of this information belongs to scientific explorations made from the colonial era to nineteenth century scientific collections, although a good deal of information is from the early twentieth century. Some 840,000 records of Mexican specimens of all taxa have been incorporated into the SNIB from foreign collections; about 92% of them have georeferenced information and nearly 8,000 of them are type speci-

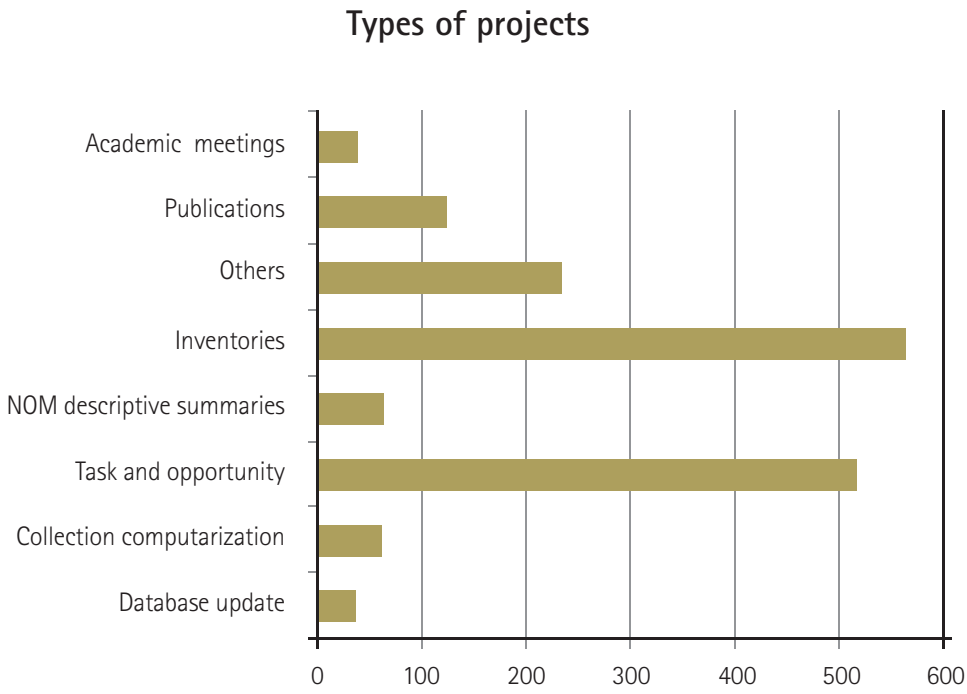

Figure 3. Supported projects.

mens. The vast majority of records (94%) come from collections in the United States, but information has also been obtained from collections housed in the United Kingdom, France, Canada, Holland, Spain and others with a total number of 32 countries comprising 278 collections.

Furthermore, almost 98,000, high-resolution images of specimens have been obtained, representing over 27,000 Mexican species. Repatriation of data was carried out with the support of projects whose leaders have been responsible for integrating information from foreign collections. This has added 914,000 specimen records. In other cases, direct collaboration agreements have been signed so CONABIO's staff may visit foreign collections to obtain digital images of specimens, computerize and georeference specimen data for integration into the SNIB, as well as processing the images to make them available to the public in accordance with the quality standards of the Commission.

Project Support

The attraction mechanism of the research projects carried out by experts has normally been to annually issue open calls to compete on specific issues established by CONABIO, according to priorities. Another important source of information for the SNIB has been the funding of projects proposed by experts and considered of interest to the Commission. Another alternative has been the funding of projects made to order by the Commission itself in order to fulfill its functions.

To date, there have been 85 requests for proposals on themes such as computerization and updating of databases, biological inventories of selected groups of organisms and/or areas of the country, ecological and genetic studies of species, publication of completed studies, and the generation of species factsheets, among others. During these two decades the Commission has funded over 1,650 research

projects (led by some 820 PI's) located in two hundred and twenty five Mexican and foreign institutions, mostly of academic nature but also governmental and social, whose work is related to the knowledge and sustainable use of the biodiversity in Mexico (Fig. 3). The description of all projects funded by CONABIO and their results are published on the website of the Commission[4].

Satellite imagery and remote sensing capacities

At present, two imagery reception systems are in operation in CONABIO: the first acquired in 2001 in collaboration with SEMARNAT and supported by the National Center for Disaster Prevention and the Natural Disaster Fund), is located at the CONABIO facilities in Mexico City, and receives both MODIS (Moderate Resolution Imaging Spectroradiometer) and AVHRR (Advanced Very High Resolution Radiometer) satellite imagery. These satellite data are used by the *Forest fire early warning and Satellite monitoring of Mexican waters* operating systems, that provide images posted daily on the website of CONABIO[5].

The second system, the *Satellite data reception station* (ERIS), is located at the facilities of the Colegio de la Frontera Sur (ECOSUR) in the city of Chetumal, Quintana Roo and was put into operation in 2007.

CONABIO has over 180,000[6] images of remote sensors, of which 32% correspond to optical satellite images, and the remainder are aerial photographs. In addition to satellite images, CONABIO has over 100,000 aerial photographs of mangroves, collected in order to ground-validate the distribution map of mangroves in Mexico. The National Institute of Statistics, Geography and Informatics (INEGI) provided 14,000 orthophotos (from 1974 to 1997) covering almost the entire national territory which have been utilized in the georeferencing of the satellite images. There are also 1,300 aerial photographs, from the 1970s and 1980s, covering the coastal areas where mangroves are located.

Geomatic tools and applications of the SNIB

In CONABIO, our geomatics area focuses on providing geospatial information relevant to biodiversity. To this end, the technology of remote sensing is applied in environmental monitoring and geographic information systems in order to enable the capture, analysis, storage and dissemination of geospatial information.

CONABIO provides the following geoinformation products to its web-page visitors:

- Geoinformation portal. Currently, this is one of the most important portals nationwide (with over 2,400 topics available to the public). It is unique in terms of the type and amount of information it provides and it allows users to not only view the images, but also to obtain the primary data they are based on.
- Forest fire monitoring system. The fire monitoring process takes place every day at a rate of up to eight times a day and is sent to pertinent users of this information almost in real time.
- Land cover map of Mexico for 2005. This is an application of algorithm classification by decision trees for the "automated" classification of images (in parallel computing).
- Algorithms for the production of information relevant to Mexico under the REDD+ framework. Algorithms are currently being developed for the production of information such as: forest cover density, analysis of change in coverage, bio-

[4] http://www.conabio.gob.mx/web/proyectos/proyectos_financiados.html

[5] http://www.conabio.gob.mx/incendios

[6] As of June, 2011

mass, etc., under the framework of the project *Reducing Emissions from Deforestation and Forest Degradation* (REDD +).

In addition to the above, other tools have been developed based on the description of the locations, for adding geographic coordinates to previous records that lack latitudinal and longitudinal data. In the last six years geographic coordinate data have been added to over 800,000 records previously collected and integrated into the SNIB.

2 | System of information support to the SNIB

The *Biótica*© Program

The Information System known as *Biótica*©[7] was designed to improve the efficiency of curatorial data , as well as parameters dealing with nomenclature, geography, bibliography and ecology. It aims to support, in a reliable and simple manner, the capture and updating of such information.

Biótica© was developed in a modular form, both in the structure of the database and in its system (programs), taking into account the wide variety of requirements of the biological community (taxonomists, curators, biogeographers, ecologists and ethnobiologists, etc.). Among other characteristics, such as the management of bar codes for labeling specimens, the system allows linkage of the database with information managed by other applications such as images, sounds, web pages, spreadsheets, databases, etc.

Geographic Information System (GIS)

GIS is the framework of spatial reference of the SNIB. Its main functions are: to update and maintain the geographic information of the SNIB, ensure the consistency of cartographic information, and to compile, systemize and analyze geographic information of value to the process of decision making related to biodiversity conservation.

The SNIB currently has more than 4,000 maps; much of it is the result of information originated in projects funded by CONABIO and other sources. Of these, more than 2,400 are displayed on our geoinformation portal and can also be found as web services. The topics include: biodiversity, topography, hydrology, soil science, geology, climatology, infrastructure, social and population attributes, among others.

Geoinformation Portal

The geoinformation portal currently has around 1,900 maps that are accessible to the general public via our website. These include 1,450 maps of biodiversity: mangrove monitoring, potential distribution of species, at risk and priority species and collective biological resources. The maps are organized into physical, biological and social themes.

[7] http://www.conabio.gob.mx/biotica5/

Priority Species Information System

The Priority Species Information System (SIEP) arose from the need for reliable and systematized information on which to base decision-making in the management and conservation of species of ecological value which are considered at risk.

CONABIO has issued three requests for projects on the subject since 2001, from which forty five research projects on Mexican species have been supported. This research has generated valuable information with which to assess the current status of 1,370 species and to evaluate any change in category of another 266 species included in the Mexican Official Norm[8] (concerning threatened species).

Information from more than 1,550 taxa has been compiled and 1,370 files have been published and made available in PDF format, along with over 340 maps, in the species section of the CONABIO website[9]. CONABIO seeks to provide an updated information system, with relevant information, in an online collaboration platform.

Information System on Living Modified Organism (SIOVM)

The concept of creating a system of reliable and systemized information on living modified organisms (LMOs) emerged in the late nineties[10]. Systematized and automated information on LMOs, in addition to forming the basis for diverse scientific analyses, can also provide clear and scientifically supported evidence in order that the government and the general public can make informed decisions on the introduction, propagation and use of these organisms. This system is the basis for meeting the requirements of the law regarding the introduction of GMOs in Mexico.

Information System on Invasive Species (SIEI)

One of the greatest threats to the biodiversity of Mexico –and the world- are invasive alien species. In order to carry out a diagnosis of the situation in Mexico in this regard, and to raise awareness and outline general actions to prevent and combat invasions, CONABIO initiated the Invasive Species Program. To date, the SIEI has a list of 1,172 exotic species, of which 570 are invasive. So far, there are 120 descriptive summaries for invasive species, along with 52 risk assessments.

CONABIO is the Mexican node of the North American Invasive Species Network, a consortium created in March 2010 to advance understanding of this topic in order to effectively respond to invasive species non-native to North America[11]. CONABIO also acts as an information clearing-house on these species in Mexico.

Global Information Network on Biodiversity (REMIB)

Since 2001, the REMIB became a worldwide interinstitutional network that shares with a number of partners its computerized biological information system of databases of scientific collections. The network nodes are the institutions where biological collections –and other sources of biodiversity data- are physically located, and where the exchange of data takes place.

---

[8] In 2001 the Mexican Official Norm NOM-059-ECOL-2000 was published, and later substituted by NOM-059-Semarnat-2001, which established an official list of species at risk of extinction.

[9] http://www.conabio.gob.mx/conocimiento/ise/fichas/doctos/introduccion.html and http://www.biodiversidad.gob.mx/especies/espPrioritaria.html

[10] It was not until the end of 2002 that external funding was obtained through the Biosecurity Project GEF-CIBIOGEM MEX/01/G32 -in relation to the implementation in Mexico of the Cartagena Protocol on Biosafety.

[11] http://www.naisn.org/

Table 2. Species recorded in the Information System on Invasive Species

Group	Invasive species	Exotic species	Exotic species under revision	Total	File with information
Bacteria and viruses	1	–	2	3	–
Fungi	11	–	–	11	–
Algae	47	2	69	118	5
Plants	266	80	455	801	62
Mollusks	18	2	3	23	7
Crustaceans	36	3	2	41	3
Insects	35	–	3	38	6
Other invertebrate	29	–	28	57	1
Fishes	90	1	11	102	9
Amphibians	4	–	1	5	3
Reptiles	6	–	3	9	5
Birds	8	3	–	11	6
Mammals	19	2	–	21	13
Total	**570**	**93**	**577**	**1 240**	**120**

The REMIB is composed of thirty-three nodes, one central (in CONABIO) and thirty-two other institutions. The nodes of the REMIB together comprise 126 collections –with more than six million data- located in five countries in America and Europe. The Network has information on the major taxonomic groups of plants, vertebrates and invertebrates –both terrestrial and aquatic- as well as microorganisms.

As a central node, CONABIO establishes the technical standards of the installation and for the use of the network, provides advice on technical issues and coordinates the participation of the institutional nodes. The REMIB uses software developed entirely in-house (*Mallos*© and *gregalis*©).

In order for users worldwide to share and make use of the global biodiversity data, REMIB was incorporated in 2006 into the Global Biodiversity Information Facility (GBIF), of which it was one of the founding institutions.

3 | Modeling and monitoring

Modeling of species distributions (GARP analysis)

In order to reduce the bias inherent in the original data, reduce field exploration costs and obtain an approximation of the ecological niche of species to estimate their potential areas of distribution, CONABIO has been developing, since 2001, models of potential distribution of species from the point data of georeferenced records and environmental variables. *Potential Distribution Models* (PDMs) have been developed for more than 3,400 species; 73% of the relevant information was generated during 2006 and 2007 by experts from collaborating institutions, especially in the case of the conservation gaps and omissions analysis (Fig. 4).

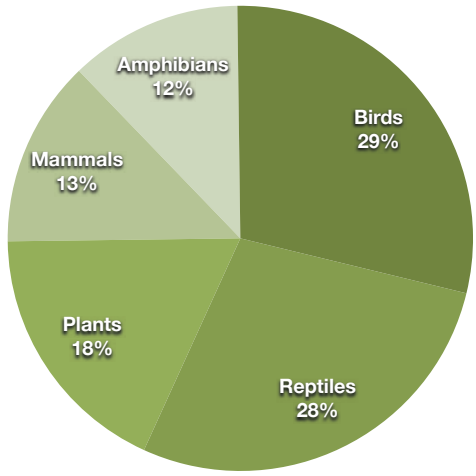

Figure 4. Percentage of potential distribution models for different groups.

PDMs are very useful instruments with which to provide technical advice in diverse areas such as risk analysis of invasive species, definition of distribution areas of species threatened by illegal trade, endemic species and those classed as being at risk of extinction, risk analysis of genetically modified organisms, delimitation of collection areas for species of interest, design of biological corridors, analysis of spatial patterns of diversity and impact assessment of future climate change, among others (Fig. 5).

Identification of Priority Regions for Diversity. Gaps and omissions in biodiversity conservation

In 1996, CONABIO initiated a *Program of Priority Regions* relating to terrestrial and marine environments, as well as epicontinental waters. The final products were thematic maps (at a scale of 1:1,000,000, with terrestrial, marine and hydrological priority regions) and the production of data files for each of the regions as well as the corresponding publications.

In 2004, Mexico made a commitment for the assessment and strengthening of its system of protected areas (PAs) in order to contribute to the global target of a significant reduction in the rate of biodiversity loss. Ecoregional scale studies of the terrestrial, marine and epicontinental gaps and omissions were conducted. These showed that of the ninety-six terrestrial ecoregions, eleven represent gaps in terms of conservation; i.e., they are not represented in the

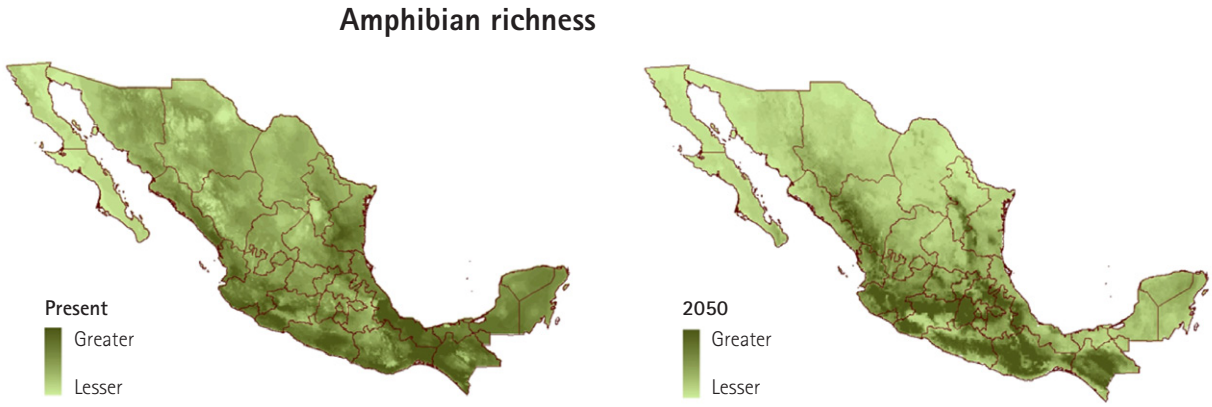

Figure 5. Estimated amphibian species richness based on potential distribution models: under current climatic conditions and under the scenario predicted for 2050.

network of federal, state or municipal PAs: The total area of these eleven ecoregions is equal to approximately 10% of the continental area of Mexico. On the other hand, fifty ecoregions (equivalent to 68.7% of the national territory) correspond to omissions of conservation (with PAs covering up to 12% of their area –the average percentage value of PA coverage worldwide) with different levels of representation ranging from 0.003 to 10.85%.

Through the analysis conducted in this area, 16.6% of the territory was identified as being of the highest priority (in categories of high and extreme priority) in terms of terrestrial biodiversity conservation, and 14.5% of the territory was recognized as being of the highest priority in terms of conservation of epicontinental aquatic biodiversity. Unfortunately, only a small percentage of the area classed as of the highest priority is contained within the PA network: 15.9% in the case of terrestrial, and 18.2% in the case of epicontinental aquatic priority sites (Fig. 6).

Due to the scientific research conducted up to now in the country it was possible, for the first time, to delineate deep-sea priority sites. More than half (55%) of the marine priority sites coincide with PAs to some degree; however, only 18.33% of the area of these sites is actually decreed as such.

The main conclusion of these analyses is that the existing PA coverage is still inadequate to represent Mexico´s vast biological diversity and to account for the complexity and the challenges facing its conservation. The intention is that analysis of gaps and omissions will identify a series of strategies that contribute to the preservation of a viable and representative portion of the national biodiversity, as well as to achieve the greater involvement of society in the conservation of Mexico´s natural capital[12].

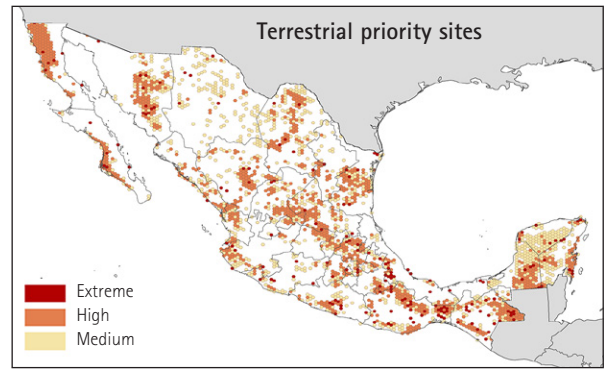

Figure 6. Priority sites for conservation of terrestrial biodiversity

[12] Maps on the theme of gaps and omissions are available in the CONABIO digital map archives. Four books on the subject will be published by 2012; three containing a poster map with additional summarized information on the topic. http://www.biodiversidad.gob.mx/pais/vaciosyom1.html).

4 | Monitoring

Land Cover

As one of its objectives, CONABIO must possess a system for monitoring land cover changes using remote sensing and analysis of geographic information systems. In 2005, we developed a method to automatically generate a land cover map that corresponds to the physical coverage of a terrestrial area: including forest vegetation, agricultural crops and urban zones, among others. The map, available on the CONABIO website[13], has nineteen land cover types for North America, of which fifteen are present in Mexico.

Mexican seas, reefs and benthic habitats

To study the behavior of marine productivity and harmful algal blooms, and the heat stress to which marine ecosystems are subject (e.g. in the coral reefs), it is necessary to study various marine biophysical and optical parameters such as sea surface temperature and ocean color, chlorophyll concentration, diffuse attenuation coefficient, concentration of total suspended material and chlorophyll fluorescence.

To provide automatically and in near-real time continuous monitoring of the former variables in the coastal marine ecosystems of the Gulf of Mexico, northeast Pacific Ocean and the western Caribbean Sea, at a resolution of one kilometer, CONABIO has developed an *Ocean Monitoring Satellite System* that allows the detection of anomalies. This system monitors oceanic parameters such as temperature and color of the sea at daily, weekly and monthly frequencies, starting from July 2002. CONABIO is also working on implementing a satellite early warning system for potential bleaching events in corals. Using ocean color observations, studies have already been conducted on algal blooms or "red tides".

Following the serious accident on the Deepwater Horizon oil platform in April 2010, CONABIO conducted an analysis of satellite images in order to monitor several oil slicks on the surface of the sea and report the results to various Mexican governmental agencies.

The *Mesoamerican Barrier Reef System* is an ecosystem of approximately 1,000 kilometers in length, comprising four countries. The National Reef Park of Puerto Morelos, Quintana Roo, was selected as a pilot area[14] for a study. This area represents a critical habitat of rare flora and for the feeding, nesting and breeding of fauna, it has high biodiversity, and features both species of commercial importance, and threatened or at risk of extinction. About 1,500 georeferenced underwater and surface photographs were obtained, as well as video recordings made of transects of the reef, providing qualitative information regarding the benthic habitat.

[13] http://www.conabio.gob.mx/informacion/gis/?vns=gis_root/usv/otras/nalcmsmx05gw

[14] Located within the Marine Priority Region "Punta Maroma-Nizuc" and within the Marine Priority Site for biodiversity conservation "Coastal Wetlands & Reef of Puerto Morelos" (from 2007).

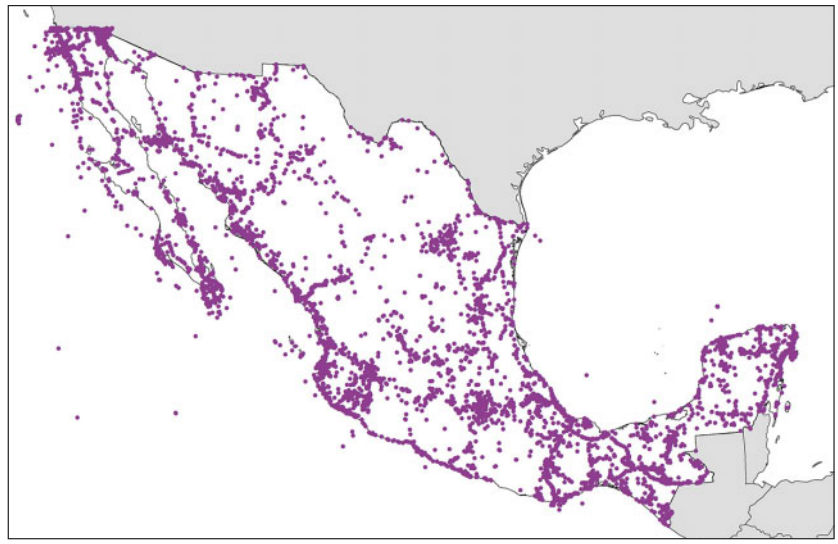

Figure 7. Number of data provided and locations of the observations in the *aVerAves* system.

Birds and citizen participation

The (BBS) is a long-term international project of large geographic scale, created in the mid-sixties in the United States in order to ascertain the state of conservation and population trends of many species of non-game birds. Over time, the program expanded to Canada and, since 2007, to Mexico with the leadership of CONABIO, which housed the Mexican section of the North American Bird Conservation Initiative (NABCI) and comprises various Mexican institutions. Currently, the BBS database[15] is public and contains information compiled from more than forty years of field-work and public participation in science, on more than 4,100 routes that are covered annually by many groups of volunteers in Canada and the United States.

In collaboration with Cornell University, the *aVerAves* site was created which is a pioneer in Mexico and permits the supervised linkage of reports made by thousands of bird watchers in the country (Fig. 7). The potential of this citizen-science activity is clearly seen if we consider that the corresponding system in the United States provided around forty million observations in 2011.

Ecosystems: Mangroves of Mexico

Mangroves, present in the seventeen coastal states of Mexico, are highly productive ecosystems and sinks of atmospheric carbon. They are rich from a biological point of view and of great economic and ecological importance. Using remote sensing techniques and field work, CONABIO has developed a program of long-term systematic monitoring over the last five years, using environmental indicators to determine the condition of the vegetation and the main agents responsible for the transformation of Mexican mangroves.

One of the main results of the program has been a map of the extent and distribution of mangroves in Mexico at a scale of 1:50,000 (Fig. 8). Analyses show that the Yucatan Peninsula contains 55% of all man-

[15] http://ebird.org/content/averaves and http://137.227.245.162/BBS/

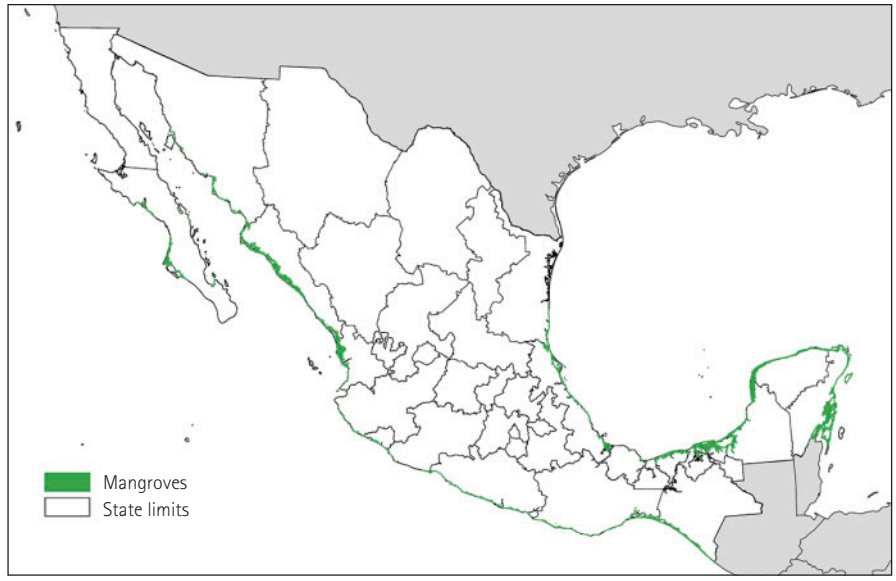

Figure 8. Extent and distribution of mangroves in Mexico in 2005.

groves in Mexico; the Central Pacific region has the lowest area, with 0.9% of the total. At present, work is progressing on the identification of the main agents of mangrove transformation throughout Mexico over a period of little more than thirty years (1970 - 2005), as well as the processes of fragmentation that affect this ecosystem.

CONABIO, in collaboration with *Google Earth*, has developed a video that shows a simple distribution of the mangrove ecosystem in Mexico, emphasizing its importance and including 3D images of portions of a mangrove. This video can be seen on the CONABIO website[16].

Early detection of forest fires

CONABIO developed and continues to operate an early warning system for forest fires, using satellite and geographical information systems. The warning system began, in an incipient form, in 1998 and since 1999 has generated information on the location of forest fires detected by satellite imagery on an automated, daily basis. The information travels electronically to those responsible for fighting fires in each state within 20 minutes of receipt of the satellite image. This information is also provided free to all the Central American countries.

Along with the information, two further products are generated: the first is a vegetation anomaly index that measures the difference between the current and the expected verdancy of the vegetation based on the estimation of vegetation data from the last nine years. The map is generated every ten days and published on the CONABIO website[17]. The second product is a model that estimates the percentage of moisture in the vegetation lying on the ground, depending on the variables of duration of precipitation, relative humidity and temperature, obtained from satellite data. Both parameters are being studied to see whether an index of fire probability can be generated.

[16] http://www.biodiversidad.gob.mx/ecosistemas/manglares/manglaresGE.html

[17] http://www.conabio.gob.mx/incendios/

5 | Analysis

Risk analysis of invasive species

CONABIO has completed fifty-two risk analyses for invasive species in Mexico, with many others in progress. Future plans include the continuation of support for risk analysis of species that are potentially harmful to biodiversity, to the economy and to public health. Also under analysis is whether to include climate change as a factor in the analysis of long-term risk.

Risk analysis of living modified organisms (LMOs)

CONABIO has developed a methodology for the *ad hoc* risk analysis of conditions in Mexico[18], aimed at preventing gene flow between the LMO in question and any wild relatives of that species existing within Mexico, at least while the consequences of such gene flow (via pollen and seed) between the LMO and wild relatives of the cultivar are not fully understood. Analyses are intended to identify potential hazards and to propose measures to prevent such risks[19]. More than 2,500 risk assessments of LMOs have been carried out under a "case by case" principle, where each case is considered within the trinomial framework "*site of release x genetic construction x receptor organism*".

Centers of origin and genetic diversity

CONABIO, in collaboration with other institutions, must provide information to SAGARPA and SEMARNAT, the ministries responsible for determining the species and areas for which Mexico is center of origin and center of diversity. Mexican law stipulates that, for the species and areas so determined (or its wild relatives) genetically modified organisms of the species cannot be released; this implies the existence of "exclusion areas" for the use of specific GMOs.

The goal of these efforts is to obtain sufficient information and knowledge to enable CONABIO to propose conservation strategies for the genetic resources of Mexico, especially those of agronomic and economic importance, in order to ensure that the existing genetic diversity is preserved for the current and future needs of the country.

[18] http://www.conabio.gob.mx/conocimiento/bioseguridad/doctos/analisis.html
[19] *Idem*

Global project of Mexican native maize

Since late 2006, CONABIO, in coordination with the National Institute of Ecology (INE,) and the National Institute for Forestry, Agriculture and Fisheries Research (INIFAP), designed and implemented the project *Collection, generation, update and analysis of information pertaining to the genetic diversity of maize and its wild relatives in Mexico*. The project is in the process of being concluded; however, it has already amply exceeded the quality and quantity of information it was expected to compile and generate. This information has already been submitted to the funding bodies of the project and has been published on the CONABIO website[20].

6 | Knowledge for the sustainable use of biodiversity and for helping generate public policies on the natural resources

Global strategy: the Convention on Biological Diversity

Since the establishment of the Convention on Biological Diversity (CBD) in 1992, CONABIO has been responsible for monitoring compliance, providing advice and representing the government of Mexico in this matter.

Natural Capital of Mexico

CONABIO coordinated in 1998 the first country study: *Biological diversity of Mexico: Country Study*[21], with the main objective of presenting a descriptive summary of the biodiversity of Mexico.

Almost ten years after the publication of this study, we had a much richer body of information, with conceptual advances, the development of new remote sensing technologies and analytical methods; with the stimulus of the publication of the *Millennium Ecosystem Assessment* MA (2005), CONABIO coordinated a second study of biodiversity in Mexico that presents a major conceptual advance, reflected even in the title of the study: *Natural capital of Mexico*[22]. This study represents an effort to capture the value of biodiversity from a societal perspective, with special emphasis on the description and analysis of the environmental services provided by ecosystems and their impact on community wellbeing.

Natural capital of Mexico consists of three volumes[23]: I. Current knowledge of biodiversity (2008), II. State of Conservation and trends of change (2009), III. Public policies and perspectives of sustainability (2009), with two more volumes in process: IV. Human, institutional and financial capacities and V. Future scenarios. In addition, a summary of the first three volumes was published for decision makers: *Synopsis: Current knowledge, evaluation and prospects for sustainability* (2009). The study is of a magnitude unprecedented in Mexico: 648 authors participated along with 96 external editorial reviewers. Mexico is the only country that has produced

[20] http://www.biodiversidad.gob.mx/genes/proyectoMaices.html

[21] CONABIO 1998

[22] CONABIO 2008 a,b; 2009; Sarukhán *et al.* 2010; http://www.biodiversidad.gob.mx/pais/capitalNatMex.html

[23] Year of publication is given in parentheses

such a comprehensive assessment of ecosystems and biodiversity for the whole of its territory.

Mexico: Capacities for conservation and sustainable use of biodiversity

A project on the assessment of capabilities and the identification of priorities for the conservation and sustainable use of biodiversity of Mexico was funded by the Global Environment Fund (GEF) through the United Nations Development Program (UNDP). The project was coordinated by CONABIO and the UNDP; it began in April 2008 with the participation of 150 experts and members of the social, academic and governmental sectors. The project concluded in 2010 with the publication of the book *Mexico: capacities for conservation and sustainable use of biodiversity*[24], in both Spanish and English.

National Strategies:

a) Biodiversity of Mexico (ENBM)

The National Strategy, assembled by CONABIO provides a vision for a half-century in which Mexico will have stopped and begun to reverse the environmental deterioration that threatens its vast diversity, and will have a broad and sufficient knowledge of its natural resources that will facilitate the making of sound decisions to promote economic development in harmony with biodiversity conservation. Such a vision will be achieved by implementing four strategic lines proposed in the ENBM: 1) Protection and preservation, 2) Valuing biodiversity, 3) Knowledge and information management and, 4) Diversification of use.

b) Invasive Species

In 2007, CONABIO began coordinating the *National strategy on invasive species in Mexico: prevention*, control and eradication with the establishment of a National Advisory Committee consisting of forty six collaborators, academics, experts in the field, officials from different agencies and representatives of civil organizations[25]. The process ranged from diagnosis of the major institutions, and their responsibility for addressing this serious threat, to the public consultation of the document.

The strategy has an ambitious goal based on three objectives: 1) to prevent, detect and reduce the risk of the introduction, establishment and spread of invasive species, 2) to establish control and eradication programs for invasive exotic species populations, with the purpose of minimizing or eliminating their negative impacts, and promoting the restoration and conservation of ecosystems, and 3) to inform society in a timely and effective manner and to develop transversal strategic actions.

c) Mexican Strategy for Plant Conservation (EMC)

CONABIO actively participated in the formulation of the Global Strategy for Plant Conservation (GSPC) and in its subsequent update. The Global Strategy sets goals and objectives designed to halt the loss of global plant diversity. Mexico, represented by CONABIO, is currently the co-chair of the liaison group appointed to guide the GSPC.

For monitoring and implementation of the GSPC at the national scale, CONABIO serves as a focal point and has led efforts towards development of the EMCV. As a first approach to the creation of a National Strategy, the document *Mexican Strategy for Plant Conservation: objectives and goals*[26] was produced.

[24] (CONABIO-PNUD 2009; disponible en: http://www.biodiversidad.gob.mx/pais/MexCapacidades.html).

[25] (http://www.conabio.gob.mx/invasoras/images/9/90/Especies_invasoras_Mexico_dic2010.pdf)

[26] CONABIO-CONANP-SEMARNAT, 2008 http://www.biodiversidad.gob.mx/pais/pdf/EMCV.pdf

Table 3. States that have published their State Biodiversity Study, with the number of authors and institutions involved.

State	Year of publication	Number of authors	Number of istitutions
Michoacán	2005	75	14
Morelos	2006	40	10
Aguascalientes	2008	83	20
Estado de México	2009	87	17
Yucatán	2010	250	47
Campeche	2010	128	28
Quintana Roo	2011	120	27
Veracruz	2011	220	40
Puebla	2011	130	22
Chiapas	2011	188	45

State Studies and Strategies for Biodiversity

In 2002, CONABIO established the State-level Biodiversity Strategies as a special program in a widely participatory process that aims for the establishment of local and transversal public policies regarding the conservation and sustainable use of biodiversity.

a) State Studies of Biodiversity (EE)

One fundamental element in the development of state strategies is the diagnosis of the knowledge of biodiversity in each state; sixteen of the 32 states have conducted studies in this regard, or are currently in the process of doing so. In total, in all the states that are conducting or have conducted these studies, more than 1,300 experts from 293 Mexican and foreign institutions have participated in the process.

b) State Biodiversity Strategy (EEB)

Several states have developed their State Biodiversity Strategies. The process of production and publication of state strategies has been supported by local, national and international institutions. EEBs are important instruments that allow states to identify threats to their biodiversity as well as the factors and actions required in the long term to ensure its sustainable use and conservation.

Environmental Restoration and Compensation

The CONABIO Program of Restoration and Environmental Compensation (PRCA, by its Spanish acronym) is a new and positive change in the funding of actions for the ecological restoration and conservation of ecosystems in Mexico. It has allowed, since its establishment in 2003, the direct channeling of resources for concrete actions toward the recovery and conservation of natural resources of our country.

Some examples of accomplishments achieved with this support are:

a) At least 10,600 ha were reforested in the Burgos basin, with soil rehabilitation over 15,000 hectares. In addition, work was undertaken in the control of erosion gullies with filter dams over an area of

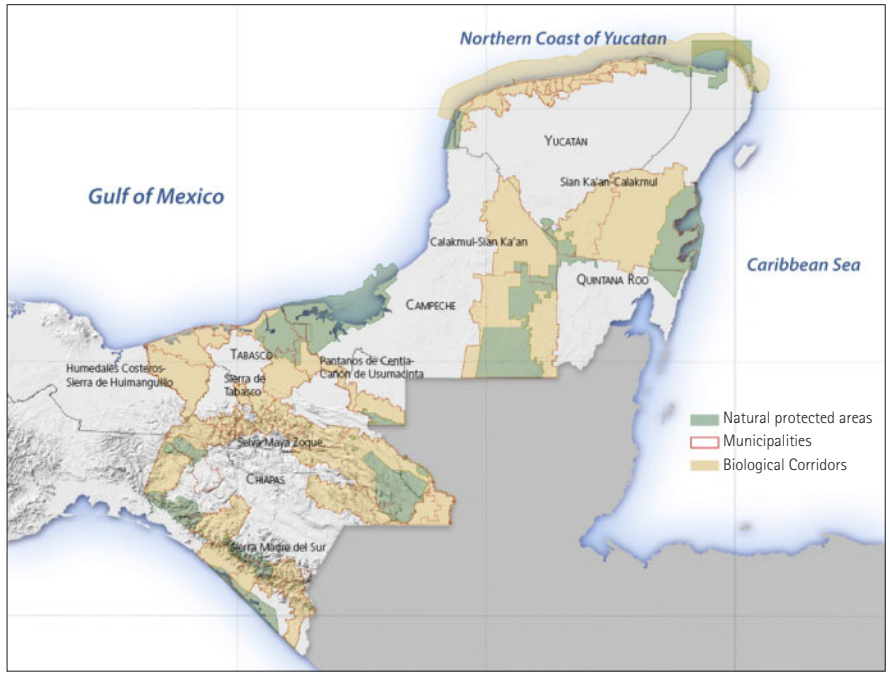

Figure 9. Location of components of the Mexican Mesoamerican Biological Corridor.

30,000 hectares; b) Monitoring of the restoration performed in the Espíritu Santo reef in Southern Baja California was supported for a period of seven years; c) Under the scheme of private land conservation, 5,000 hectares of tropical montane cloud forest have been set aside for conservation for a period of thirty years ; d) In the Tehuacán-Cuicatlán Biosphere Reserve, resources were channeled towards the monitoring of populations of the military macaw (*Ara militaris*) and for the development of a protection program for this species.

Mesoamerican Biological Corridor–Mexico (CBMM)

The Mesoamerican Biological Corridor is a regional initiative involving Mexico, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama in an effort to protect remaining natural ecosystems. Its purpose is to maintain the connectivity of Protected Natural Areas through corridors that permit the movement of animals and dispersal of plants, contributing also to the improvement of quality of life for local people through sustainable management practices that generate income in the communities.

In 2003, the Commission began operating the CBMM, with the function of consolidating the experience gained so far in the establishment of corridors in the southeast of Mexico, as well as managing the Program of Collective Biological Resources (Fig. 9).

The project operates in eight corridors located in the states of Chiapas, Yucatán, Quintana Roo, Campeche and Tabasco[27]; it is currently being

[27] Selva Maya Zoque (Northern Chiapas), Sierra Madre del Sur (Southern Chiapas), Calakmul - Sian Ka'an (Campeche), Sian Ka'an - Calakmul (Quintana Roo), Costa Norte de Yucatán (Yucatán) and Sierra de Tacotalapa – microbasin of Huitiupán, Cañon and wetlands of Usumacinta and wetlands of la Chontalpa (Tabasco)

extended to the state of Oaxaca. Some preliminary experiences obtained in the biological corridors project provide evidence that it is possible to reconcile care for nature with economic Benefits for people. Over these years, the CBMM has worked with a total of 628 rural communities, with a combined population of more than 85,000 people receiving the benefits. It is estimated that one third of this total is comprised of indigenous people. One important result of the efforts of the MMBC has been to achieve the inclusion of environmental criteria in the guidelines and requirements of the federal public investment programs in the humid tropics.

Productive–Chains Project

The objective of this project within the CBMM is to promote sustainable production chains of goods and services, based on biodiversity, to underpin a development strategy in the southeastern region of Mexico that reconciles the conservation of ecosystems and improvement of income and the living conditions of their inhabitants.

Collective Biological Resources

CONABIO began in 2001, the *Collective Biological Resources Program* (PRBC) to promote common property resources based on sustainably harvested biological resources. The program has worked with social, academic and governmental organizations in several Mexican states.

The overall objective of the Program is to support innovative models of collective and sustainable ownership of CBR in order to promote appreciation of the countryside, *in situ* conservation of biodiversity and the improvement of the quality of life for both rural communities and urban consumers. Resources that have been involved include: the pita-fiber plant (*Aechmea magdalenae*), Mezcals (from various *Agave* species), aromatic copals (from several species of Bursera), honeys of the Yucatan peninsula and the Caribbean spiny lobster (*Panulirus argus*).

7 | International collaborations

Global Biodiversity Information Facility (GBIF)

Mexico has been part of the governing board of GBIF since its inception, represented by CONABIO which played a decisive role in its development, orientation and in its line of work, actively participating in the development of its current data transfer protocol. This presence has been of utmost importance as it has allowed Mexico to continue driving the digitization and distribution of primary data[28]. CONABIO carried out two GBIF funded projects: *Quality control and georeferencing of Mesoamerican specimens in the Missouri Botanical Garden and Species Population Loss Meter*.

[28] Various European and North American museums house very significant quantities (hundreds of thousands to millions) of Mexican data and still have not computerized their collections.

CONABIO supports the creation of a global initiative: IPBES

The United Nations Environment Program proposed the creation of a body that periodically produces global and regional assessments, and provides support for capacity building in information management associated with biodiversity: *The Intergovernmental Platform on Biodiversity and Ecosystem Services* (IPBES). CONABIO, representing the Mexican government, has participated actively, supporting the initiative in three intergovernmental consultative meetings (Malaysia, 2008; Kenya, 2009 and Korea, 2010).

Encyclopedia of Life (EOL)

The Encyclopedia of Life (EOL) is an international initiative that seeks to gather and share the most complete scientific knowledge on each of the known species of the planet, having a page for each known species on the Planet and making this information accessible to all society through the Internet. Since November 2008, CONABIO has taken part in developing this initiative as part of the Advisory Council and the EOL Institutional Council, which includes distinguished representatives of the international scientific community, and represents numerous institutions and programs key to the implementation of the strategy. In 2010, the Commission signed a memorandum of understanding to collaborate with EOL as a partner and to contribute with both financial support and data regarding the species of Mexico. From August 2011, there has been information available on a growing number of Mexican species and has initiated the production of the Spanish language version of EOL.

8 | CONABIO as an advisor and training facility

CONABIO: The CITES Scientific Authority of Mexico

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) aims to ensure the sustainable use of fauna and flora that are subject to international trade. In Mexico, CITES entered into force in 1991 with CONABIO designated as a Scientific Authority (SA). Mexico is the country that has presented the most periodic status reviews in the Appendices of CITES, thus ensuring that the inclusion and classifications of Mexican species are up to date and appropriate.

CONABIO currently coordinates evaluation projects of Mexican priority species such as the marsh crocodile (*Crocodylus morelettii*), updates the CITES Identification Guide for the most traded birds and mammals in Mexico, produced to assist customs agents and, together with CONAFOR, coordinates the National Inventory of Candelilla (*Euphorbia antisyphyllitica*).

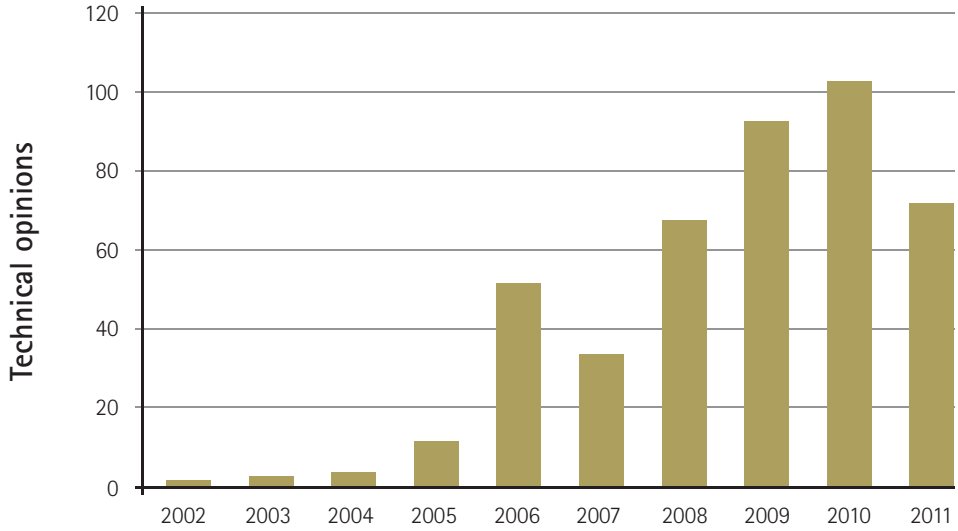

Figure 10. Technical opinions issued to June 2011.

National Assessment of Management Units for the Conservation of Wildlife (UMA)

The UMA is a mechanism created in 1997 with the aim of protecting those ecosystems from which biological components can be sustainably extracted for the economic benefit of the landowners involved. Currently, there are over 10,000 UMAs covering more than 35 million hectares, equivalent to 18% of the Mexican territory. CONABIO, along with SEMARNAT, is currently coordinating an evaluation of this system that has important potential in terms of sustainable productive management of biodiversity as well as of important sources of economic income to the owners of the areas under management.

Technical opinions on environmental impact assessments

Ten years ago, when requested by the authority responsible (General Directorate of Environmental Impact and Risk), CONABIO reviewed and issued technical opinions on the environmental impact assessments (EIA) and Justificatory Technical Studies (JTS) required for approval of development projects for industry, tourism and trade (Fig. 10). The information provided by CONABIO is based on the primary data of the SNIB regarding biodiversity, and on digital mapping, including maps of potential distribution of species.

International Training

For its international prestige and innovatory capacity, CONABIO receives many invitations to participate in relevant international forums and is visited by the most distinguished scientists and other people related to biodiversity. It has established a close relationship with various countries in order to exchange experiences (Kenya, Colombia, all the Central American countries, among others) and has collaborated on numerous successful international courses.

9 | Communication and dissemination of knowledge regarding the biodiversity of Mexico

Requests for information from society

The function of providing external services to the general public, and to the environmental sector in particular, began with the creation of the Commission in 1992. In 1996 we started recording the responses to the consultations requested by different groups of society. From then until the present, around 10,200 requests for information have been attended (Figs. 11 and 12).

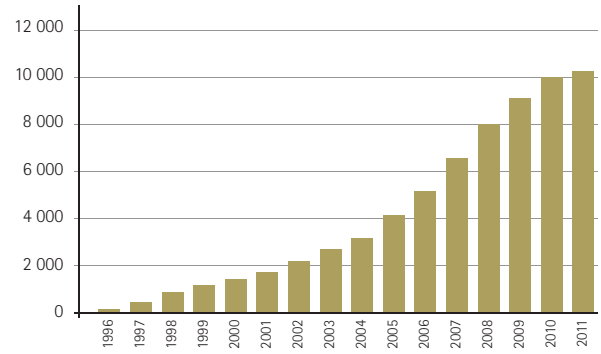

Figure 11. Cumulative number of external services addressed, to June 2011.

Web Site

In addition to the original CONABIO page, a new website entitled *Mexican Biodiversity*[29] was made available in late March, 2009. This was developed with the purpose of stimulating the interest of users in the subject of biodiversity, and to generate information that could be accesibly transmitted to the general public with the hope of producing an ample social and cultural impact, reflected in the public knowledge and the sensibility towards the conservation of Mexican biodiversity.

The *Mexican Biodiversity* site is composed of nine themes presented in a hierarchical manner: *biodiversity, ecosystems, species, genes, corridor, region, country, planet and uses*. This format allows the users to choose the level of complexity of information they wish to access.

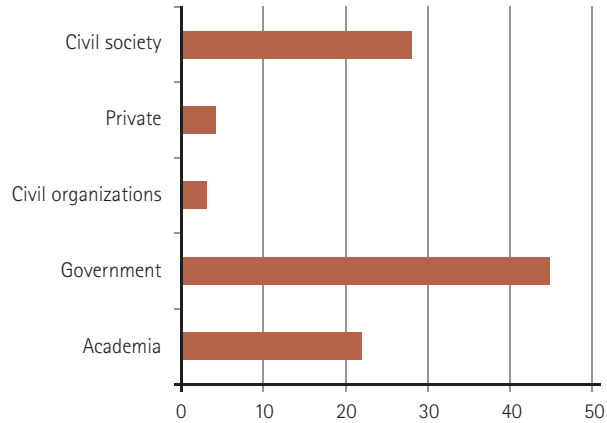

Figure 12. Proportion of external services attended by sector (%).

[29] www.biodiversidad.gob.mx

Use of the portal

User statistics for the CONABIO website have been recorded since 1996 and for the *Mexican Biodiversity* website since publication in 2009. The number of page accesses increased rapidly until 2006 and continued to fluctuate until 2009. From 2011, another substantial increase has been recorded. From 2009 to the present, the average number of monthly visitors, to the CONABIO site only, is 19,000 users from sixty two countries, while the *Mexican Biodiversity* site receives 51,000 visits from seventy three countries, making a total of around 70,000 visitors to the portal per month.

In October 2010 the Mexican Biodiversity website was chosen as one of ten winning projects, at national level, in the category *Mente Imagen of the Mentes Quo + Discovery* initiative of the *Quo* Journal and *Discovery Channel* television network, where it competed with other websites, video, film and television.

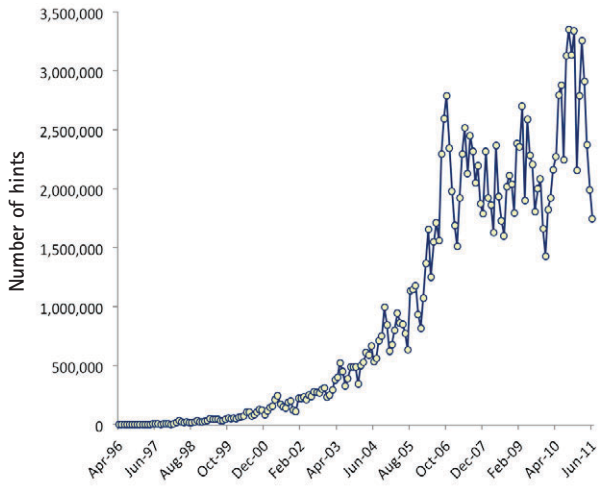

Figure 13. Monthly access statistics to the internet portals from 1996 to June 2011 (number of hits).

Web site for children

In February 2010, as part of the event *International Year of Biological Diversity 2010*, the interactive children's site known as *El país de las maravillas* was made available in order to present knowledge of the natural wealth of Mexico. Among the most prominent users were the Secretariat of Public Education of the Distrito Federal, the National Council for Educational Development (CONAFE), the General Direction of Indigenous Education of the Secretariat of Public Education (SEP), the Papalote Children's Museum and the Chapultepec Natural History Museum.

The main objective of this new website[30] is to present Mexican biological diversity in an educational and entertaining manner, conveying knowledge, but above all stimulating the curiosity of the children through cartoons, photographs, videos, games and sounds. To promote the dissemination of this site, a total of ninety-three radio capsules have been produced and distributed to radio stations nationwide.

Image Bank

The creation of the CONABIO Image Bank became a concrete project in the year 2003; it began with a collection of nearly 1,400 illustrations and an equal number of digitized slides. At the creation of the CONABIO website, (1996) 3,000 photographs and low resolution digital illustrations were made available to the public for use in school projects and presentations about the biodiversity of Mexico. Presently, high resolution images are also available for specific purposes such as exhibitions, journals, textbooks and websites, among others. The bank contains now almost 77,000 images, of which more than half have been made available on the internet. The images included in the bank are complemented by taxonomic and geographic information as well as the various vernacular names and the scientific name of the species.

[30] *Idem*

Mosaico Natura México (in collaboration with National Geographic)

In November 2010, the page Mosaico Natura México was created by CONABIO in collaboration with the National Geographic magazine in Spanish. Its aim is to bring the public closer to the nature of Mexico by using high quality artistic images as well as to promote Mexican nature photographers. Currently participating in this collaboration are 184 photographers from nineteen Mexican states.

Biodiversity of Mexico on *You Tube*

The CONABIO site on YouTube, created in May 2009, includes interviews with CONABIO staff, videos of events, exhibition openings and presentations of books and documentaries. The Commission has initiated the collection and purchase of videos on flora, fauna, ecosystems, landscapes, and uses. To date, ninety-six videos have been published and these have been played more than 47,000 times.

10 | Publications

Editions

For the dissemination of information, publications have been supported both in terms of proposals coming from external institutions and the programs and projects coordinated by the areas that make up the Commission itself. From 1992, support was given to publications on the biodiversity of Mexico through the issuing of specific calls. With this mechanism, around 500 titles have been published, providing data, analysis, descriptions, proposals, suggestions and reflections on various topics of biodiversity.

Biodiversitas

In 1995, we started publishing the bimonthly newsletter *Biodiversitas*, an editorial space where authors discuss different topics associated with Mexico's biological wealth in plain language and addressed to a broad audience (Fig. 14). The publication is aimed at schoolteachers, students and the general public. In 1996, *Biodiversitas* received an honorable mention by the Designers Council of Mexico and in 1997 it received the Quorum[31] award for best newsletter. Ninety nine editions have been published, featuring 267 articles written by 370 authors. Current circulation is 3,000 copies and it is available on the CONABIO website.

Figure 14. *Biodiversitas*: the bimonthly newsletter of CONABIO.

[31] Quórum, Consejo de Diseñadores de México, A.C

Distribution of publications

Publications supported by CONABIO can be purchased either on site or through the online catalog[32]. Another method of acquisition is via the more than sixty five points of distribution nationwide.

Mexico´s Natural Heritage: One Hundred Successful Case Studies

To celebrate the Bicentennial of Independence and the centenary of the Mexican Revolution, the book *Mexico´s Natural Heritage: One Hundred Successful Case Studies* was produced by CONABIO. This work gives testimony to the successful experiences of conservation, management and restoration of the natural heritage of Mexico, and includes experiences from twenty-one Mexican states. One hundred and forty authors describe the development of the work[33].

Figure 15. *Mexico's Natural Heritage: One Hundred Successful Case Studies* first edition.

11 | Media and outreach

Media

In 2008, the media office was established in CONABIO with the aim of establishing a direct and constant relationship with television, radio and the press in order to generate more and better opportunities to broadcast the knowledge of the natural wealth of Mexico.

Outreach

CONABIO began in 2008 to increase their participation in outreach events, some organized in collaboration with other agencies. These events reach various sectors of society and constitute an opportunity to disseminate the materials generated by the Commission: books, websites, posters, reports, photo exhibitions, among others. Since 2003, photographic exhibitions have been organized in various public spaces and there has been participation in conferences, seminars, meetings and presentations, to very different groups of people, on Mexico's biodiversity and the functions, programs and projects carried out in the institution.

[32] http://www.biodiversidad.gob.mx/publicaciones/publicaciones.php

[33] The work is available for consultation on the CONABIO website, featuring a search by themes, ecosystems, states, authors and institutions. http://www.biodiversidad.gob.mx/pais/cien_casos/cien_casos.php

Internal communication

In 2008, the systematic organization of internal seminars began with the intention of publicizing and disseminating the work of researchers and institutions in the environmental sector. The number of seminars has been increasing, with seventy seven events to date. To this can be added the initiative of the Open Door day, which CONABIO has carried out for five consecutive years, where students, academics, family and the general public are invited to see some of the Commission´s activities first-hand.

12 | Towards the future in CONABIO

In 2006 and 2007, the senior staff of CONABIO conducted a prospective assessment of the information and intelligence requirements for decision-making that Mexico is likely to need in the fifteen or twenty years ahead, with respect to the knowledge, sustainable management and conservation of biodiversity. It became clear that the definition of future development had to be based on the experience, information gathered and methodologies built over the twenty years of activity of the Commission. Based on these elements. it was possible to establish the priority areas on which most of the human and financial resources should be focused (without neglecting the other subjects worked on by CONABIO). The main areas for development were:

1) A comprehensive revision and overhaul of the SNIB to consolidate it as the backbone of reliable, up to date and accessible national information on biodiversity. This has reached completion.
2) Development of the existing capabilities for remote sensing and geomatics analysis
3) Emphasis on international relations at the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for the protection of species listed in the NOM 059-SEMARNAT.
4) Expansion of the universe of users and providers of data using web tools and social networks, with particular attention to the electronic communication of information generated by CONABIO
5) Working together with a greater number of communities and associations in the primary sector to align various government policies within an ecological concept of development.

In the years that have passed since this analysis regarding the future direction of CONABIO (2007-2022), ambitious programs have been launched for the digitization of the largest scientific collections deposited in Mexican institutions. As a result of these programs –which will continue for several years- the volume of information held by the SNIB is expected to increase significantly. In recent years CONABIO has participated, in collaboration with CONAFOR, in strengthening the National Forest and Soil Inventory, in aspects of methodologies for further data acquisition and in the improvement of existing data. Calls have also been made to conduct studies on the biodiversity of the State of Morelos, which already has a CONABIO- supported biodiversity information state agency with local staff and participation of the state's academic institutions.

In addition, a new long-term program has been launched for the monitoring and knowledge of the Mexican seas. Currently, CONABIO is the only institution in Mexico that daily generates publicly available information on oceanic variables, such as

sea surface temperature, marine productivity, and concentrations of algae, among others, and that has initiated a monitoring study of the health of a portion of Mexico's Caribbean barrier reef.

Based on the growing experience of CONABIO in the acquisition of information by remote sensing and geomatics, as well as on the availability of new remote sensors that allow finer estimates –to which we already have access or can expect to have it in the near future- our capacity is advancing in terms of determining important ecosystemic operating variables such as vegetation cover of the country, net primary productivity, carbon content of different ecosystems and different vegetation indices that have applications in other systems beyond natural ecosystems (crop and pasture areas, for example).

CONABIO is now at the stage of conceptual and methodological definition to develop capacities that allow it to provide information on the use of Mexico´s natural resources not only for those interested in aspects of knowledge, conservation and sustainable use of the biodiversity contained in natural ecosystems, but rather to extend the information to all potential users. For example, farmers and cattle producers could be possible beneficiaries of services of this type offered by CONABIO over the next decade.

Vision of CONABIO for the next two decades

- It is an institution of excellence, recognized nationally and internationally as the point of reference and information which influences the acquisition of knowledge about biodiversity and the methods of conservation and sustainable use of the terrestrial and marine biodiversity of Mexico.
- It provides the government and citizens of Mexico –based on its permanently updated and improved National Biodiversity Information System- with reliable information concerning the status of Mexico´s ecosystems and their components, as well as their value and performance in terms of provision of environmental services.
- It promotes, formally and regularly, the use of such information by decision makers at different levels, and ensures that such information is obtained validated and updated by the sustained participation of scientists, producers in the field and citizens.
- It utilizes the most advanced computational methods and is a global point of reference with respect to the collection, handling and use of information on the Natural Capital and its use in making decisions of importance to different sectors of Mexico.
- It houses interdisciplinary groups contributing to the knowledge and sustainable use of Mexico´s Natural Capital, especially in the field of bioinformatics due to its ability to generate new technologies, remains embedded as a leader in its field, and plays an active part in the most relevant international initiatives.
- It participates in the training of personnel and the consolidation of State level agencies that collaborate with their governments in increasing the knowledge and sustainable use of their natural resources.
- It drives initiatives that promote citizen scientific participation and acquisition of information for enhancing the knowledge of Mexican biodiversity.

13 | Administration

Human Capital

The Commission currently has a staff of 248 persons, of which two hundred and nine are professionals that play substantive roles in the fields of biology, ecology, veterinary science, geography, mathematics, systems, physics, environmental economics and environmental law. The remainder of the staff performs clerical activities in support of the substantive work of the Commission.

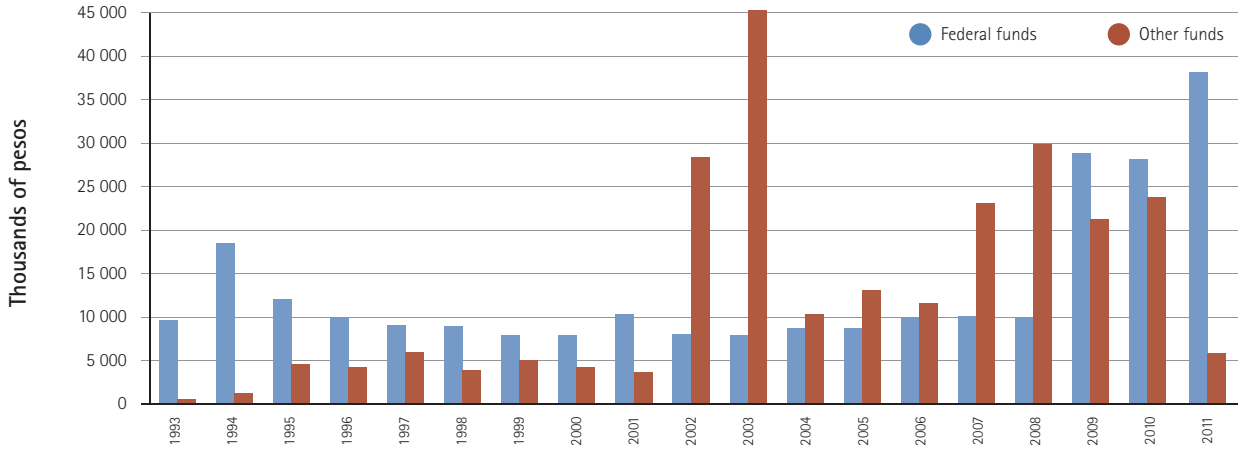

Figure 16. CONABIO income 1993 to June 2011 (Real pesos from June 1993).

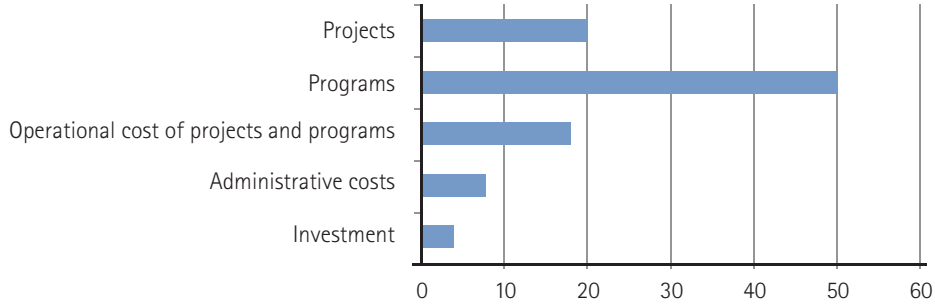

Figure 17. Expenditure from 1993 to June 2011 (%). Real pesos from June 1993.