

Mexico

THE MEXICAN LONG TERM ECOLOGICAL RESEARCH NETWORK

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Long-term studies of ecological processes are relatively scarce despite the fact that many environmental phenomena of concern today (e.g., changes in global temperatures) were documented through the long-term monitoring of key variables. Because ecological processes occur at varying spatial and temporal scales, it has been a formidable challenge to relate the results of short-term and small-scale studies to long-term and larger-scale phenomena (Ehleringer and Field 1993). Unfortunately, long-term studies are infrequent (Tilman 1989), due to the lack of long-term funding and because the systems for evaluating scientific productivity have pushed investigators to emphasize short-term studies that yield rapid results. Long-term studies, however, are essential to distinguish between single events and cyclic patterns or directional trends (Magnuson 1993) and can facilitate the description of natural variability and establish the baseline condition of ecological systems (Franklin et al. 1990; Gosz 1996).

Mexico's participation in the International Long Term Ecological Research Network is important for several reasons. As a result of Mexico's geographic situation and topographic complexity, it supports high levels of species and ecosystem diversity, representing a major fraction of the earth's biota (McNeely et al. 1989). It is imperative that the country understands and protects this heritage because the combination of extensive rural poverty, low technical support and high population growth has led to a rapid land-use transformation in the country. Scientific understanding of the effects of land-use changes on natural ecosystems is necessary for developing practices toward sustainable management and conservation. Additionally, Mexico is affected by ecological processes that operate at continental scales, such as the El Niño–Southern Oscillation, which occur infrequently and can only be understood through collaborative long-term and large-scale efforts. Finally, the proximity of Mexico to a well-established network of long-term studies creates the opportunity for scientific cooperation and development of human resources.

Description of program, objectives, and core areas

In order to implement the proposed Mexican LTER (MEXLTER) we have organized a committee to structure the network. Presently, the committee has completed the proposal and is working with the government to define long-term funding mechanisms.

The fundamental philosophy of the MEXLTER will be to address ecological research at large temporal and spatial scales in a fashion that has not been generally practiced in Mexico. Through the network structure, sites will have similar projects and share standardized data. The MEXLTER program is designed to encompass terrestrial and aquatic ecosystems, including managed ones. National-level studies should allow comparisons within and across biomes. At an international level, it should facilitate comparisons within and across biomes in different geographical areas. Therefore, the network

should have representation of the major biomes within the country, making it desirable to place replicated sites within biomes.

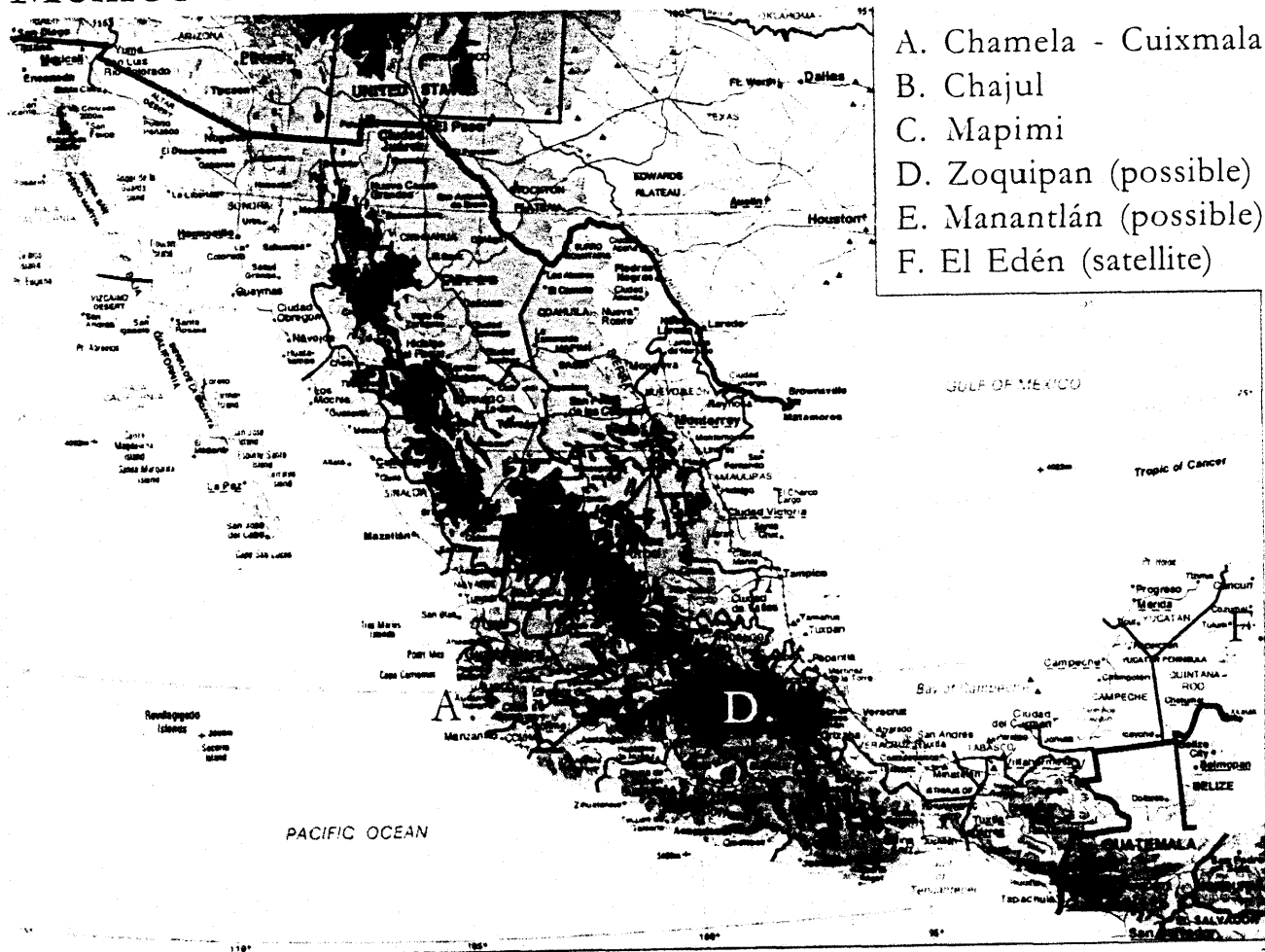
The objectives of the MEXLTER are as follows:

1. Establishing a network of sites to allow Mexican scientists to address in an interdisciplinary way ecological issues on broad spatial and temporal scales. A corollary is to understand the role of biological diversity in ecosystem processes and in the provision of services to the biosphere, including humans.
2. Creating a legacy of well-designed and documented experiments and observations for future generations.

At present we are in the process of formally establishing the MEXLTER, working on an agreement with the National Council of Science and Technology to obtain funding for beginning the Network Office and the initial network of sites. We anticipate that the network will be established this year.

Seven core subjects will define the basic theoretical framework for the research conducted at the

Mexico LTER Sites



sites. These subject areas address the most relevant functional and structural features of ecosystems, and the most pressing environmental issues for human welfare. Within each topic area there will be a background and a hierarchy of three levels of detail which will set the priorities for data acquisition. The core areas are:

- ♦ Patterns and control of ecosystem primary productivity
- ♦ Patterns and control of water, carbon and nutrient dynamics in ecosystems
- ♦ The role of biodiversity in the structure and functioning of ecosystem
- ♦ Patterns and frequency of ecosystem disturbance
- ♦ Effect of climate change on the structure and functioning of ecosystems
- ♦ Interactions at the interface level between managed and natural ecosystems
- ♦ Defining criteria for ecosystem management and conservation

Site Characteristics

Participating sites will be required to fulfill a number of criteria necessary to secure the long-term and large-scale viability of this initiative. All sites will be subject to continuous performance evaluation carried out through independent peer review. The minimum criteria for a site to be eligible for the Mexican LTER are: 1) critical scientific mass; 2) commitment to sharing the resulting data and its long-term management; 3) participation of a higher-level institution and evidence of its commitment; 4) institutional stability or security of site for the future; 5) adequate infrastructure and logistics; and 6) existing knowledge base (availability of long-term data sets).

In order to allow a large number of sites and scientists to be part of the MEXLTER, the organizing committee has decided to have two different types of sites in the network: official sites and satellite sites. Official sites already have the history, the infrastructure, the number of scientists involved in research, and the support of an established research institution. Satellite sites have limited infrastructure, support and research, and an interest in joining an official site in doing research in a particular core area. Such sites may evolve into official network sites in the future.

At present we are in the process of selecting the first sites to be incorporated in the MEXLTER. We have four candidate official sites, a possible official site, and a satellite site. We describe in detail two of the official sites and the satellite site. We also mention the three additional official sites. The distribution of these sites in Mexico is presented in the map (left).

Site Descriptions

Site name/location: Chamela-Cuixmala Biosphere Reserve, Jalisco coast, Western Mexico. Official site.

Latitude, longitude, elevation, size (ha): 19°22'4"-19°35'29"N, 104°56'23"-105°3'36"W, 0-350 meters elevation, 13,141 ha.

Principal contact/institution: Gerardo Ceballos and Andrés García, Fundación Ecológica de Cuixmala, A.C. and Instituto de Ecología, Universidad Nacional Autónoma de México. Felipe Noguera, Estación de Biología Chamela, Instituto de Biología, Universidad Nacional Autónoma de México.

Principal biome/main communities: Tropical dry deciduous forest, tropical semideciduous forest, riparian

LTER vegetation, arroyo forest, xerophilus scrub, mangrove, manzanilla forest, reed beds, palm plantations, dune and aquatic vegetation, and introduced grasslands.

Research topics: Long-term monitoring of environmental variables, long-term monitoring of fauna species populations; effects of seasonality on the biology and ecology of flora and fauna; effects of traditional management on ecosystem properties; conservation biology of endangered species; entomofauna inventories and monitoring.

History of site: The Chamela Biological Field Station was instituted in 1971; the Cuixmala Ecological Foundation was created in 1988; the Chamela-Cuixmala Biosphere Reserve was established in 1993;

the proposal to include the Reserve in the LTER network was made in 1997.

Types of data collected: Flora and fauna inventories since 1971; air temperature, precipitation, insolation and relative humidity since 1977; budgets, pools, and internal fluxes of energy, water and nutrients since 1982; tree species demography since 1984; solar radiation, wind speed and direction since 1986; evaporation since 1987; tree germination and seedling establishment since 1988; monitoring rodent species diversity and abundance since 1988; reproductive patterns and conservation of sea turtles since 1988; population status and conservation of the American crocodile since 1988; activity and movement patterns in the carnivore species community since 1994; monitoring of herpetofauna and insect diversity and abundance since 1995; maps of soils and topography, chemical composition of precipitation, cloud water, population records and biomass of terrestrial and aquatic fauna and flora, stream water, vegetation composition, above- and below-ground biomass, tree growth/mortality, litterfall, litter decomposition, mycorrhizal associations, phenology, streamflow.

Site name/location: Chajul Tropical Biology Station. Located in the state of Chiapas, Mexico, in the Montes Azules Biosphere Reserve. Official site.

Principal contact/institution: Dr. Rodrigo A. Medellín, Instituto de Ecología, Universidad Nacional Autónoma de México.

Latitude, longitude, elevation, size: 16° 07" N, 90° 56" W; 120 m asl. The Montes Azules Biosphere Reserve covers 331,200 hectares.

Main biome/communities: Tropical rainforest, mesophilous forest, riparian forest, riverine and lake ecosystems.

Research topics: Successional processes, ecosystem productivity and nutrient cycles, effects of human activities on mammal community and population ecology, seed dispersal, plant-animal interactions.

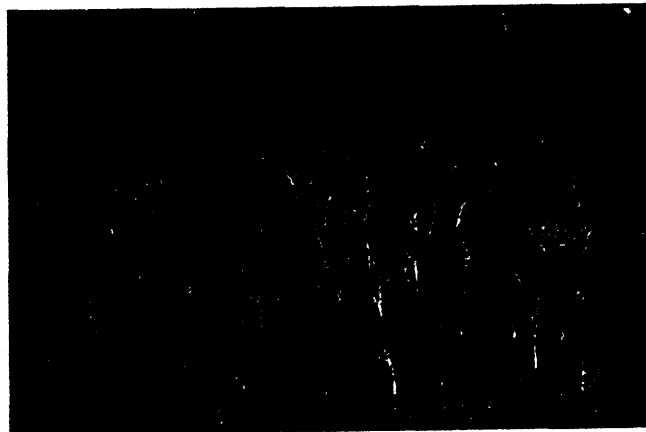
History of site: The Chajul Tropical Biology Station was built by the federal government in 1986 and abandoned two years later. In 1990 the National Autonomous University of Mexico (Institute of Ecology) and Conservation International established a partnership to co-manage the Station. The Montes Azules Biosphere Reserve is part of the largest remaining tropical rainforest tract in Mexico and Middle America. It is inhabited by the Lacandon Indians in the north of the reserve. Its vast mahogany content was actively exploited from the 19th century through the 1960s. Today it faces deforestation threats in its northern and western limits.

Types of data collected: Plant and animal inventories, primary productivity as related to soil nutrient contents and successional stages, small mammal density, demography, and diversity, seed dispersal by vertebrates along a disturbance gradient, insect herbivory, ant-plant interactions, butterfly ecology.

Site name/location: Mapimi biosphere reserve, located in the Mapimi Bolson area, in the vertex formed by the Mexican states of Chihuahua, Coahuila and Durango, Mexico. Official site.

Principal contact/institution: Miguel Equihua, Instituto de Ecología A.C., Nalapa.

Lucina Hernández, Reserva de la Biosfera de Mapimí, Instituto de Ecología, A.C., Centro Regional Durango . Luis Carlos Fierro, Instituto de Ecología, A.C., Centro Regional Durango .



Dry forests in the Chamela-Cuixmala Biosphere Reserve (Photo G. Ceballos).

Latitude, longitude, elevation, size (ha): 26°11' -27°00' N, 103°23' -104°07' W, 1100-172,000 m, 172,000 ha.
Principal biome/main communities: Chihuahuan desert, desert shrubland (*Prosopis glandulosa*, *Larrea tridentata*, *Fouquieria splendens*), desert grassland (*Hilaria mutica*), salt shrublands (*Atriplex canescens*, *Atriplex canthocarpa*)

Research topics: Biological inventories (vertebrates, plant, and invertebrates), ecological monitoring of weather, monitoring of subterranean and superficial hydrology, vegetation monitoring of ecological process, comparative ecological researches with African and North American deserts, studies of endangered species, population ecological studies. Studies of human systems (archeological, historical, demographic patterns, and traditional use of land studies). Studies of rangelands.

History of site: Mapimi was the first Biosphere Reserve in Latin America, it was created in 1978.

Types of data collected: Flora and fauna inventories since 1976, ecological monitoring of climate since 1976, underground and surface hydrology since 1982, resource maps of geology, land use, soils, topography and vegetation since 1988, comparative investigations of ecological processes since 1981, studies of endangered species since 1976, studies of wildlife population dynamics since 1976, archeological and sociological studies since 1985, rangeland management studies since 1976.

Principal contact/institution: Miguel Equihua, Instituto de Ecología A.C., Xalapa.

Site name/location: Zoquiapan experimental station, located in the state of Mexico, in central Mexico. Possible official site.

Principal contact/institution: Armando Equihua, Colegio de Posgraduados, Universidad Autónoma de Chapingo.

Site name/location: Reserva de la biósfera de Manantlán, located in the states of Jalisco and Colima in western Mexico. Possible official site.

Principal contact/institution: Eduardo Santana, Universidad de Guadalajara, Jalisco, Mexico.

Site name/location: Reserva Ecológica El Edén, 36 Km. W of Cancún, Yucatán Peninsula, Municipality of Lázaro Cárdenas, Quintana Roo, Mexico. Satellite site.

Principal contact/Institution: Arturo Gómez-Pompa, Department of Botany and Plant Sciences, University of California, Riverside, C.A.

Latitude, longitude, elevation, size (ha): 21° 12' 36" N; 87° 11' 37" W; 5-10m; 1,492 ha.

Principal biome/main communities: Semi-deciduous tropical forest; savannas; wetlands; secondary growth; caverns; sink holes.

Research topics: Long-term monitoring of biological diversity; population dynamics (amphibians, reptiles); integration of ecosystems, species distribution, land tenure, development patterns and geographic information systems; vegetation



Monitoring reptiles and amphibians has provided important information about the dry forests of the Chamela-Cuixmala Biosphere Reserve (Photo: G. Ceballos).

history of the Yalahau Region; ancient Maya settlement and use of wetlands; restoration ecology; regeneration processes caused by natural and human induced perturbations (hurricanes, droughts, forest fires); Chemical diversity.

History of site: Acquired and established as a private reserve in 1990 by Arturo Gomez-Pompa and Marco A. Lázcano-Barrero; La Savanna Research Station established in 1993

Marco A. Lazcano; La Savanna Research Station established in 1993

Types of data collected: Population records and biomass of terrestrial and aquatic flora and fauna; maps of vegetation, disturbance history since 1976; two sets of aerial photography since 1980; climatological data since 1998.

Information Management

Maintaining the integrity of long-term databases requires the establishment of secure data storage, backup systems, standardization of reporting procedures and protocols for documenting how data were collected. Each participating site will designate an information manager who will be responsible for the establishment and maintenance of databases for that site. Information managers will work together to assure compatibility and accessibility of data among sites. The MEXLTER network will promote the calibration of analytical techniques being used at each of the sites to assure adequate quality control and comparability. The necessity for standardized data collection and documentation within and across sites in the network requires that participants from each site be trained in information management, the acquisition and use of remotely sensed data, and the collection and analysis of climatic data.

Several standards will be followed to insure the successful development and implementation of the MEXLTER network. The complexity of present-day environmental processes and problems, and the philosophy of the MEXLTER network to conduct ecological research on these issues, requires that all participating sites use similar state-of-the art conceptual and technical tools such as networking, data base management, geographic information systems, and modeling.

Cross-site Research

One of the reasons for establishing a network of research sites is to encourage the development of large-scale and comparative studies. The establishment of such studies will require frequent communication among potential collaborators in order to define possible joint studies. In order to facilitate such communication, the network will organize meetings of all the scientists involved in the long-term research at the participating sites. Meetings will be held every other year during the development of the project and will be designed to maximize interchange of ideas during the formative phase of each research project. Additional goals of the meetings will include the introduction of participating scientists to the concepts of long-term research networks and the importance of key aspects such as data management and the use of remotely sensed data.

Network Management

The implementation of the LTER network in Mexico will require a coordinating mechanism that provides support for the establishment and funding of the research sites. The achievement of the common goals of the network will require centralization of certain processes such as training, network communication, and planning of meetings. In addition, by centralizing other elements such as the acquisition of equipment and software, we anticipate improving efficiency and reducing cost. The basic structure for the coordination and operation of the network consists of an Executive Committee, an Advisory Board, a Network Coordinator and a coordinator for each site. Management of the LTER network will be by an Executive Group with representatives from each of the participating sites.

Partnerships

The MEXLTER will work cooperatively with the National Council of Science and Technology, the National Commission on Biodiversity, and the Ministry of Environment, Natural Resources and Fisheries (SEMARNAP). Other partnerships will be developed with other governmental and academic institutions and NGOs.

Collaboration among Networks between the MEXLTER and regional networks will be made through regular conferences. The MEXLTER is actively involved with both the North American and Latin American regional networks. Global collaborations will be made via the Internet and specific meetings.