

MONTHS 13 TO 18 ACTIVITIES REPORT

EC Contract number ERB IC18 - CT98 – 0262

UNIVERSIDAD NACIONAL DEL CENTRO DE LA PROVINCIA DE BUENOS AIRES (Partner 3)

Scientific Coordinator: Dr. Graciela Ana Canziani

The group at UNCPBA is formed by members of NUCOMPA:

Dr. Graciela Canziani, Professor, Mathematics and Mathematical Ecology,
Ing. Rosana Ferrati, Engineer in Water Resources and Graduate student in Mathematics,
Lic. Paula Federico, Graduate student in Mathematics,
Ing. Ana Canonica, Engineer, Computer and Systems Engineering.
Diego Ruiz Moreno, advanced student in Computer and Systems Engineering (joined this group in Nov. 1st, 1999).

And also by other Faculty members who devote part of their research time to the project:

M.V. Fernando Milano, Professor, Natural Resources and Sustainability, Facultad de Ciencias Veterinarias,
Dr. Marcelo Gandini, Professor, Ecology, Remote Sensors, Facultad de Agronomía,
Dr. Roberto Sánchez, Professor, Environmental Management, Facultad de Ciencias Humanas.

This group participates in the development of several different tools and models to be used by other project partners:

- i. Hydrological models
- ii. Dynamic vegetation maps
- iii. GIS to organize in systematic form data provided by previous and present studies on the region
- iv. Population models for several species of macrovertebrates that are particularly important relative to the management of resources.

Recent Developments

We feel that we have been able to keep the pace of our work within the work plan and timetable of our project in spite of delays due to the difficulties in having access to historical data records, and to the gaps in some of the data series. Other problems we encounter are due to fact that some information is simply non existent. This affects mainly the hydrological models and forces us to look for alternative modeling approaches. Besides, we are expecting field data collections by other partners that have not been completed as yet, particularly in regard to the *marsh deer* and *capybara* species, such as vital rates and population parameters.

The tasks to be developed by this group and numerous and time consuming, so there is a need for more people working on them. We will try to involve advanced students in short duration specific tasks, but is necessary to consider some retribution in

order to assure their dedication. We have obtained the collaboration of Lic. Laura Moreno, from Facultad de Agronomía, who has helped with the digitalization of the topographical maps.

GIS and vegetation maps

We are working on the development of several layers in the GIS, including the soil map and the topographic map. We are also analyzing changes in the system by comparing historical satellite images and new images provided by CONAE. As previously stated, our project has been included as part of the SAC-C mission carried on by the National Commission for Spatial Activities (CONAE) together with NASA and European Spatial Agencies. Unfortunately, the launch of satellites SAC-C and EO-1, which belong to the Morning Watch Constellation, is being delayed by NASA. Nevertheless, CONAE is providing us with simulated images, which allow us to perform some of the analysis that we programmed.

A SAC-C simulated satellite image was used to define different landscapes as a basis for the modeling of habitat and the dynamics of vertebrate species in the Iberá macro-system. Landscapes definition was carried out using field data and the image (175 m. spatial resolution). We achieved the definition of seven different habitats that will be used in the population model analysis of vertebrate species. Our methodology was based on homogeneous polygons definition on the field through the utilization of GPS data and location of vegetation censuses on a topographic map.

This resulted in the definition of seven distinct habitats (lagoons, tidelands, weedlands, and 4 types of dammedlands; see fig. 1) with different characteristic of vegetation coverage and anegability corresponding to different habitat suitability for vertebrate species (Table 1) (Waller 1999 per. com.).

Table 1

CLASS DISTRIBUTION FOR SELECTED AREA				
	Class	# samples	Percent	Class reliability
1	Lagoons	68111	3.0	99.9
2	Embalsado 1	52624	2.3	64.3
3	Embalsado 2	213950	9.5	95.8
4	Embalsado sph.	137723	6.1	71.4
5	Estero	65163	2.9	98.6
6	Malezal	1090909	48.4	85.1
7	Crop land	568777	25.3	100.0
8	Embalsado 4	55005	2.4	94.0
	TOTAL	2252262	100.0	

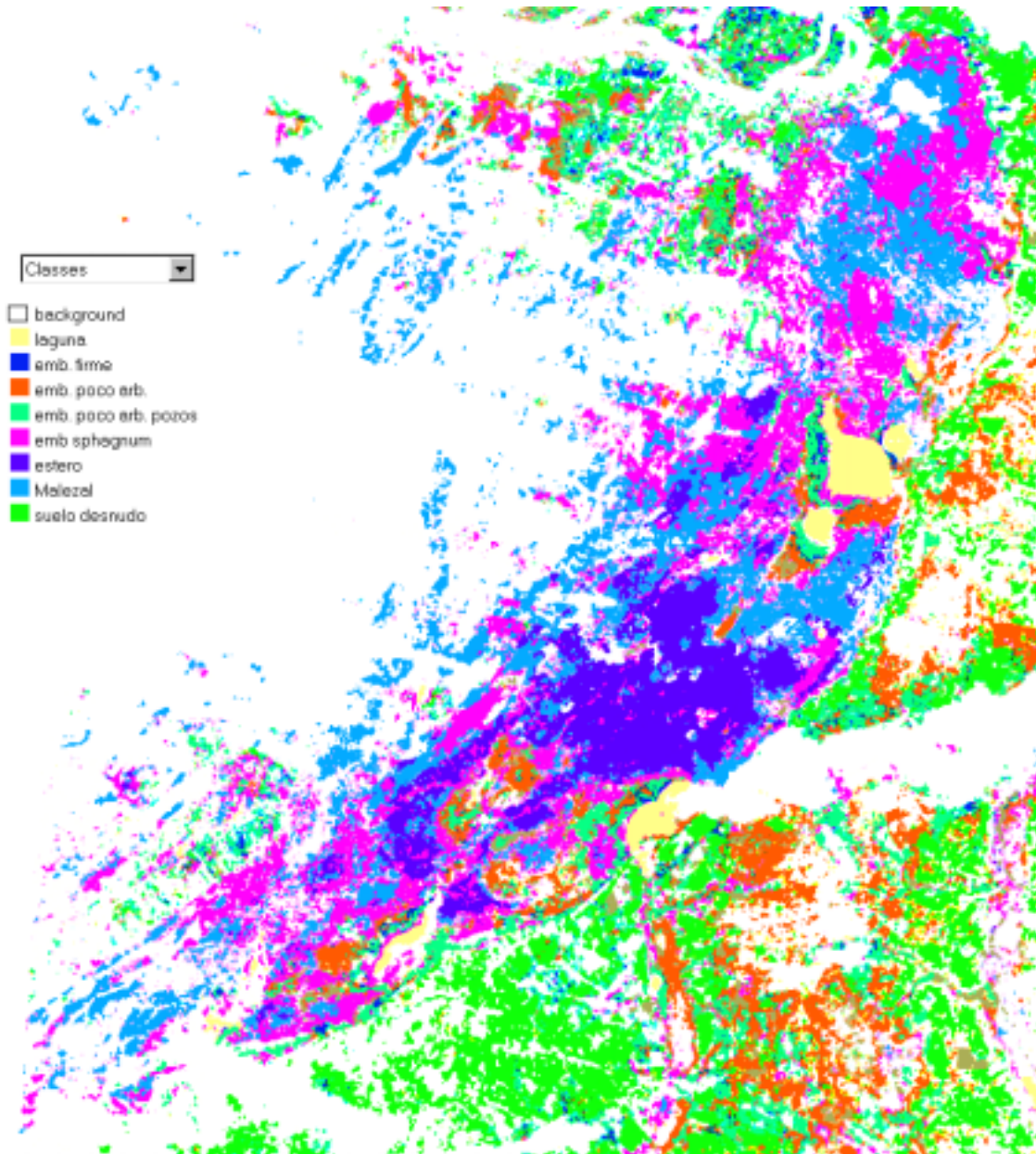


Figure 1: Habitat delimited by maximum likelihood method.

The confusion between different habitat is acceptable: it is within a range between 92.5 % and 100% for five habitats, and 50 to 66% for two very similar types of dammedlands, with an overall class performance of 98.6%.

Therefore SAC - C images appear as a good option to define landscapes in vast zones and of low environmental variability as Ibera and similar wetland systems given their spatial and spectral resolution.

Hydrological Models

Regarding the water balance models, two variables had been studied; precipitation and evapotranspiration.

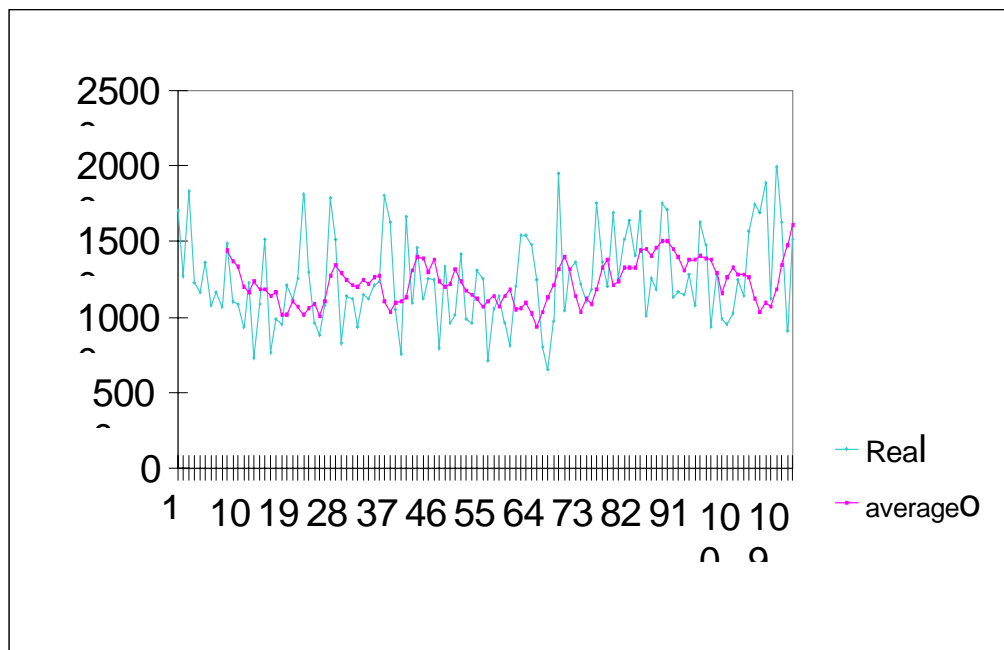
(a) Precipitation

Based on the rainfall data compiled up to date, the analysis of the historical series available from the neighboring observation stations will be undertaken both for the annual and monthly precipitation values.

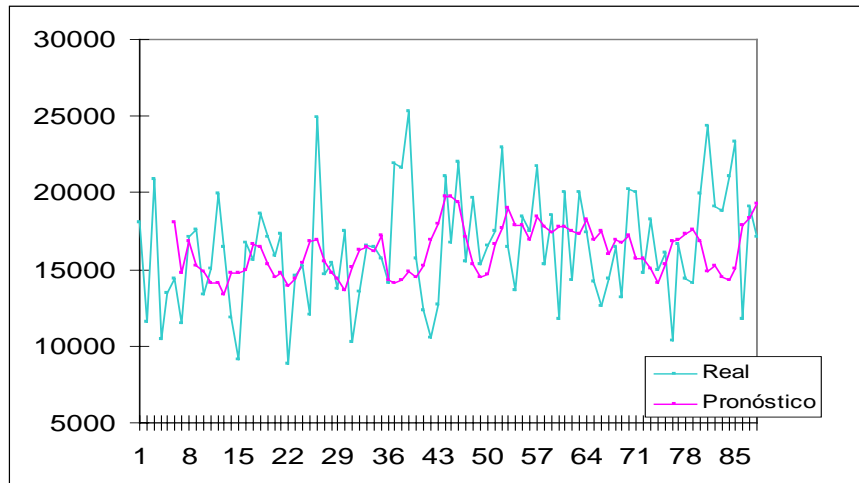
In respect to the observation stations located inside the ecosystem, which, in a general way, are of short record, the data will be contrasted/controlled to analyze their consistency.

A moving average method was applied to historical data of precipitation from meteorological stations in Corrientes (station 871660, OMM) and Posadas (station 871780, OMM).

The available data period for Corrientes was 1876 – 1989 and the result are visualized in the following plot.

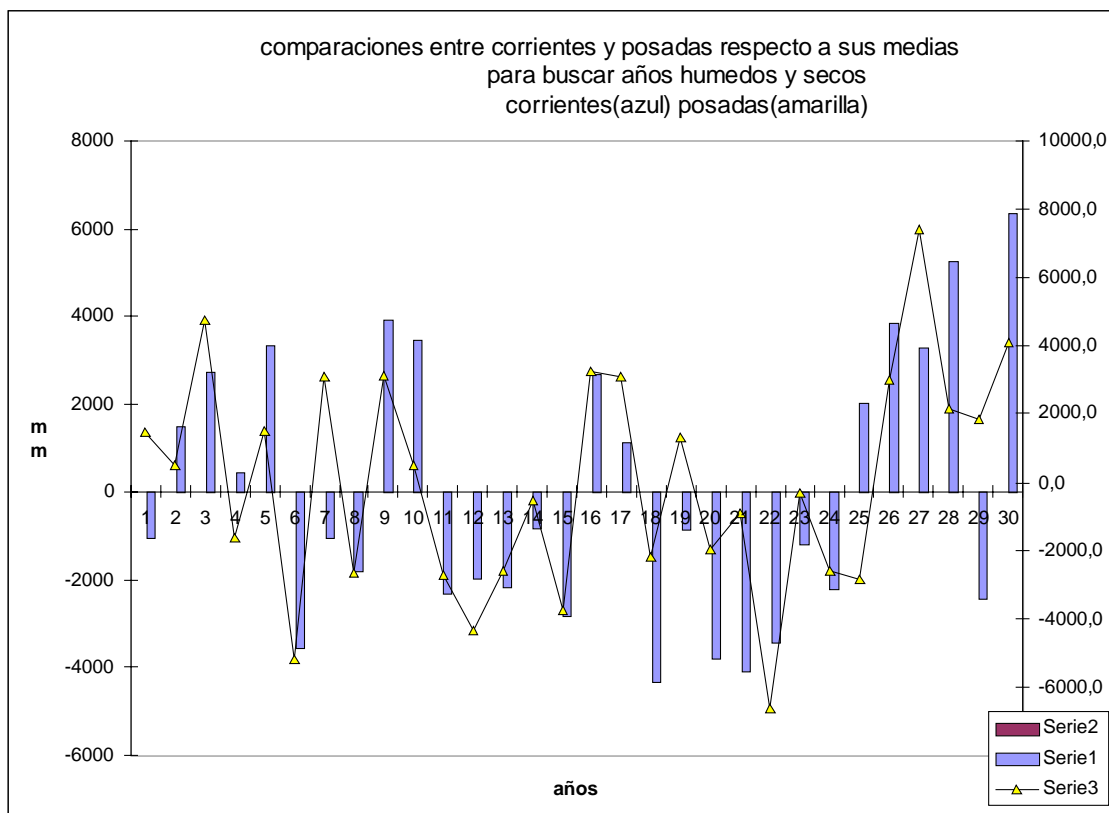


The available data for Posadas covers the period 1903 – 1990, giving the following plot:

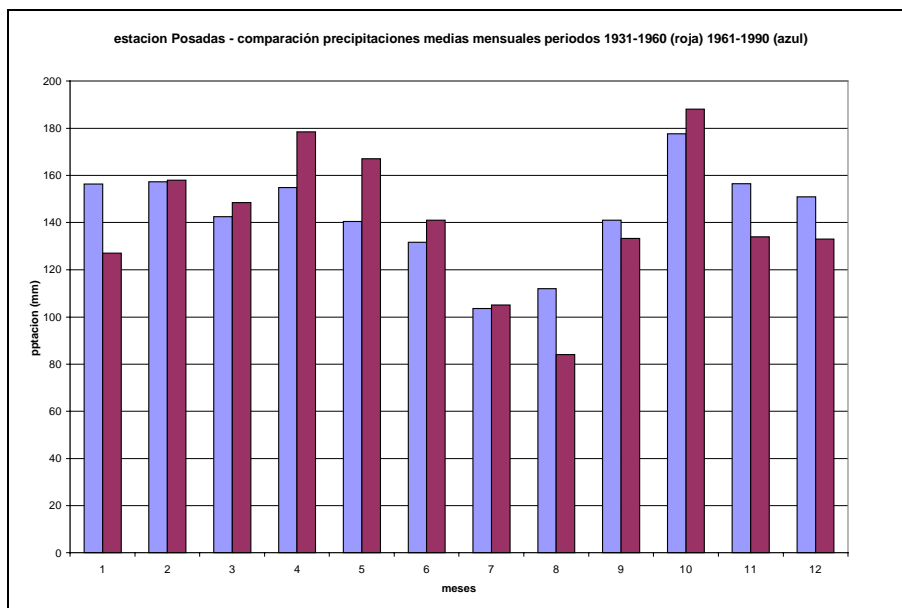
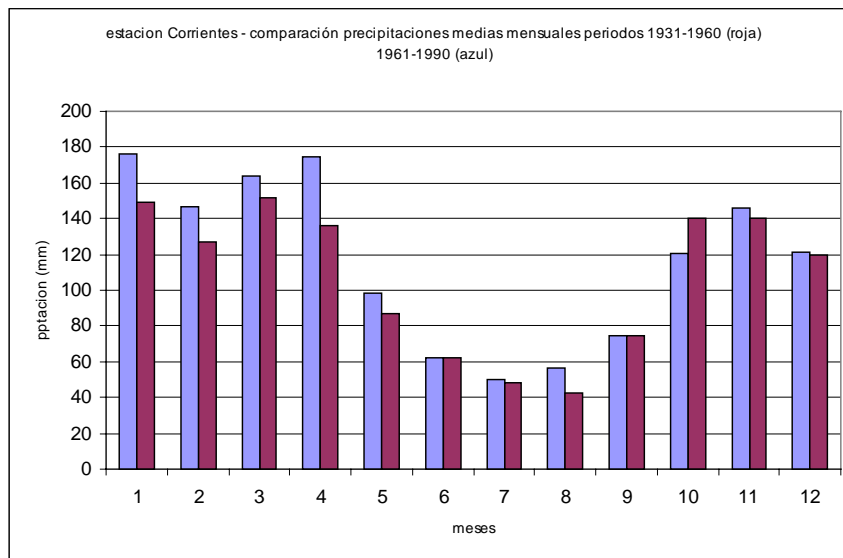


The method of moving averages with a preceding period of five years reflects the memory of the system. The results agree with the variations that can be observed in the hydrometric levels data series recorded for the Ibera Lagoon over the same period. Nevertheless, the high precipitation values recorded over the last portion of the period rise the average well above historical values. We do not have precipitation data for the last ten years.

The analysis of wet and dry periods has been done over a normalized period of thirty years with respect to the means, for data from the stations at Corrientes and Posadas.



The normal monthly averages between data series from 1931-1960 and 1961-1990 were performed for comparison, resulting in variations among them:



(b) Global water balance

The Iberá Ecosystem behaves as a consolidated natural system responding to a function which main characteristic is the water storage. The main input variables are precipitation and the evapotranspiration demand. The main overflow is the discharge to the river Corrientes. The underground water may behave as an input or an output of the system and it is likely that it assumes both capacities in different places and times. In first instance it

may be included as a variable of the state of the system, being assumed as making part of the storage. The underground input resulting from the Parana River in Rincón Santa Maria is excluded, taking it as an input volume to the system.

We are attempting the construction of a model based on finite elements method that may help us calculate the flow of water from the Parana River at Rincon Santa Maria. We expect that Ente Binacional Yacyreta, which controls the dam over the Parana River, will provide the necessary data for the parametrization of the model.

(c) Evapotranspiration

We are evaluating a first approximation of the EVT using the Thornthwaite empirical method on the mean monthly temperature data, as published in The 1961-1990 Global Climate Normals, of the WMO – CD-ROM, for the stations Corrientes, Posadas, Mercedes and Paso de los Libres. The average monthly normal temperature has been evaluated and the corrected evapotranspiration potential calculated. At this moment, we do not have the monthly temperature record of the cited stations needed to calculate the vertical water balances, only data from NOAA for the year 1994 to 1997.

The project's meteorological stations located in Galarza, Iberá and Concepción generate the data from within the ecosystem required to compute the evapotranspiration.

Ecological Models

We expect to complete in the following months the task of determining the parameters that will be used in the *Capybara* models. This is currently being done using data published in research journals and from information gathered from personal communications with experts in these species. Next we will analyze the sensitivity and elasticity of the model with respect to these parameters, and validate the models and later tune them using field data provided by partners. We expect to complete the process in the next months, depending on the availability of field data. As stated previously, we anticipate some difficulties in the determination of stage or size dependent fertility and survival rates because we have not found yet any specific studies, but will try to develop a methodology to obtain these from existing data.

We have also been working on a cellular automata model for the analysis of spatial distribution patterns. Although the work is not finished, the results so far are encouraging. We expect to use such an approach for the analysis of movement patterns for the *Marsh deer* populations over the region already identified as the appropriate habitat for the species.

Scientific Exchange

In the month of December 1999, we had the visit in Tandil of Prof. Joao Meyer, partner from UNICAMP, who shared the teaching of a Graduate Course on Finite Elements Method, and taught a Seminar on Finite Differences Method.

During four weeks in March 2000, the *Fifth Course on Mathematical Ecology, including an Introduction to Environmental Economics* took place at **the International Center for Theoretical Physics (ICTP)** in Trieste, Italy. Prof. Graciela Canziani (UNICEN) was one of the Directors of the Course, while Professors Claudio Rossi (Siena), Charles Perrings (York), Vincent Hull (LabRoma), and Dr. Steven Loiselle (Siena) were Lecturers. Prof. Joao Meyer (UNICAMP) contributed with material for a Workshop on Pollutant Dispersion. One lecture, shared by Prof. Canziani and Dr. Loiselle, was devoted to the Ibero Project. Participants Manuela de Castro (UFRGS) and Paula Federico and Diego Ruiz Moreno (UNICEN) presented three communications on partial results obtained within the frame of this project.