

A report about the activities completed during 2006.

Implications of changes in demographic and land-use patterns on the biodiversity of Atlantic Forest in Misiones, Argentina

Abstract

For many years, tropical forests have been deforested for agriculture, grazing, and timber extraction. Nevertheless in the last decade there has been a dramatic increase in rural-urban migration in many Latin America countries. This demographic change has direct effects on patterns of land use, which, in turn, directly affect loss or conservation of biodiversity.

The province of Misiones possesses the largest area of remnant Atlantic Forest, which is an important global conservation priority. During the last 30 years, Misiones is experiencing rapid socioeconomic changes, which have important implications for conservation of the region. The major goal of this project is to understand the interactions among patterns of human demography, land-use, and biodiversity.

Project location

The study area comprises the province of Misiones, Argentina. Misiones contains the major area of continuous remnant of Atlantic Forest, which has been reduced to 7.8% of its original distribution. This eco-region contains a high biological diversity with an exceptional concentration of endemic species and is considered a high priority for conservation by principal global environmental NOGs, such as CI's Hotspot and WWF's Global 200. During the last decades, Misiones has experienced rapid socioeconomic change. Some of the most important factors include: expansion of mono-specific plantations, subsidies to increase cattle grazing, and an increase in rural-urban migration.

Goals

The major goals of the project are: 1) understand the interactions among patterns of human demography, land-use, and biodiversity and, 2) use this information as a basis for developing future land-use/conservation scenarios for the province of Misiones.

Objectives

The specific objectives of the project are: 1) Describe the relationship between demography and land use patterns, and 2) Describe how changes in land use patterns have affected the distribution, diversity and composition of bird, amphibian, and ant communities.

Research activities

During 2006, I have completed the first phase of the project. This consisted in the spatial and temporal changes in demography and economic activities in Misiones, and the changes in land use patterns in the province. For this, I have analyzed data from the National Population Censuses and the National Farm Censuses from 1988-2002. With these data I characterized the major demographic and main productive activities during the last 20 years in Misiones. Then I analyzed satellite images from 1973, 1980, 1987/89 and 2006 for determine changes in the main land use: forests, agriculture, pastures and plantations associated to rural-urban migration

Now, I am development the second phase the project. I am documenting the impact of land-use change on the biodiversity with censuses of birds, amphibians and ants in the main land-use detected. Birds and amphibians have been censuses by detecting calls using automated remote recording devices. Ants have been collected from the leaf litter and pitfall traps. This information will show the overall demography and land-use trends, and will provide an index of how the fauna is responding to different land-use patterns.

I will use the information generated in this project as a basis for developing future scenarios for the province. Specifically, I will focus on how to balance the expansion of grazing land and tree plantations, with the need to expand and link natural area reserves in Misiones. A major component of this phase will be to coordinate workshops with representatives from the provincial and local governments, local NGOs, industry, tourism, and local communities, and to lead a working group that will develop the scenarios. A major contribution of this phase will be a database of the most recent information, which will be shared among all participants. I believe that this activity will be an effective way to improve the decision-making process and conservation efforts in the region.

Results

DEMOGRAPHY

At provincial level there was a dramatic increase in the total population, but all the growth was in the urban population (Fig. 1). There was a slight decrease in the rural population between 1991 and 2001.

The change in the rural populations varied greatly among the departments (Fig. 2). The departments can be grouped into three groups: 1) five departments which had an increase (≥ 2.000 inhabitants) in the rural population; 2) five departments with little change in the rural population; and 3) seven departments which had a decrease (≤ 2.000 inhabitants) in the rural population.

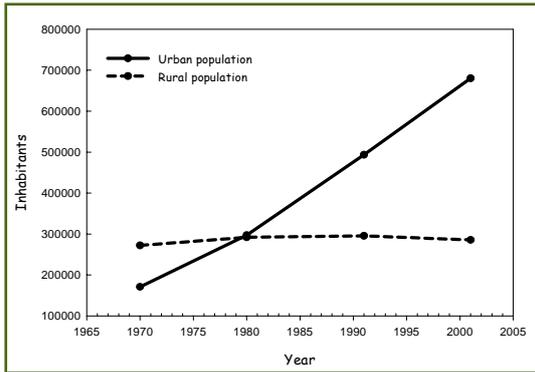


Fig 1: Change in the urban and rural population of Misiones in the last decades

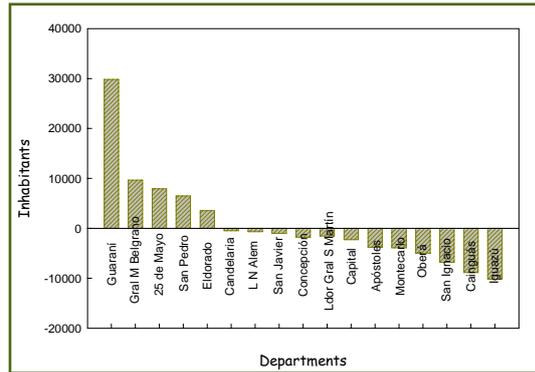


Fig 2: Change in the absolute rural population between 1970 and 2001 for each department

LAND USE

At provincial level

Between 1969 and 2002, there was a dramatic increase in the area dedicated to plantation, mainly pine. The area dedicated to agriculture declined, and there has been a steady increase in area dedicated to pastures (Fig. 3)

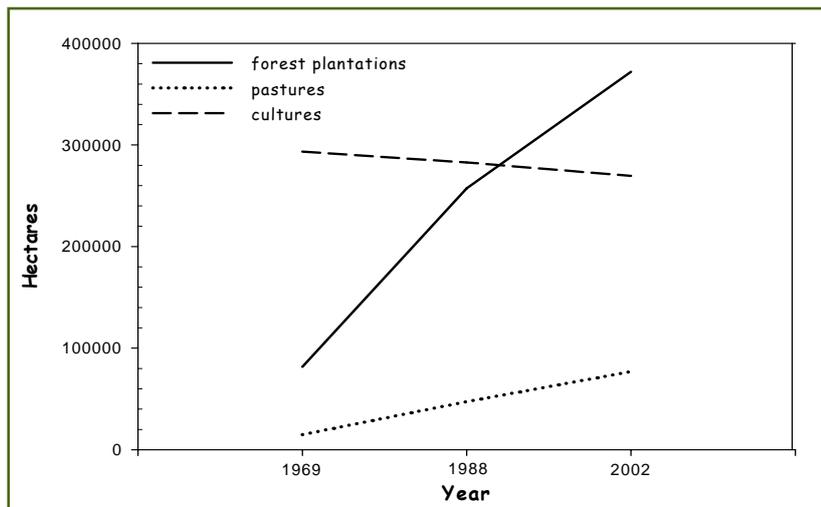


Fig 3: Change in area dedicated to the three most important land-use categories in Misiones.

The ordination of three departmental groups through time shows that each group began with a very different land-use composition in 1969, but with time the three groups are converging on a similar pattern (Fig. 4)

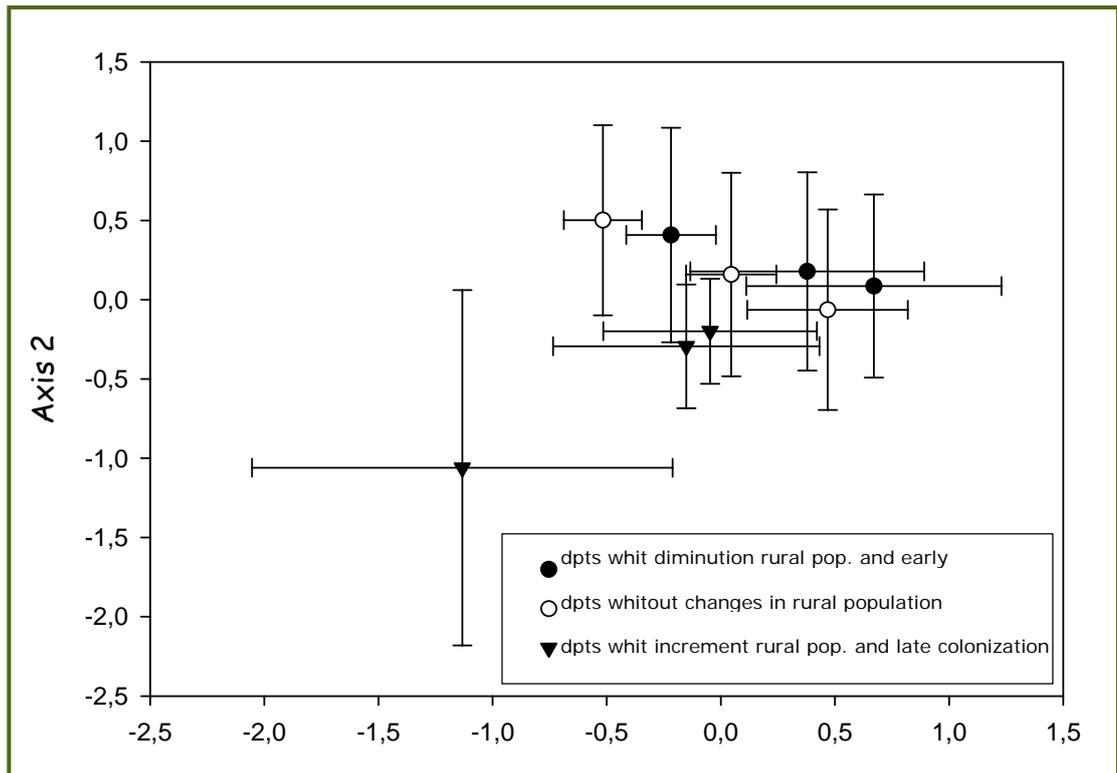


Fig 4: Change in the composition of land-use categories through time in the three groups of department that reflect difference in colonization time and rural population dynamics.

At departmental level

Departments with a decreasing rural population had an increase in forest plantations and a decrease in pastures and agricultural lands. Montecarlo was the exception with a decrease in plantations and an increase in pastures.

Departments with little change in the rural population also showed an increase in forest plantations and a decrease in pastures and agricultural areas. Alem was the exception with a dramatic increase in pasture lands.

Departments with an increase in the rural population had an increase in all categories as forest was converted to these uses. El Dorado was the exception with a decrease in agriculture lands and increase in plantations.

Satellites image's analysis

I classified four mosaics: 1973/74; 1979/80; 1987/89 and 2006. (Fig 5)

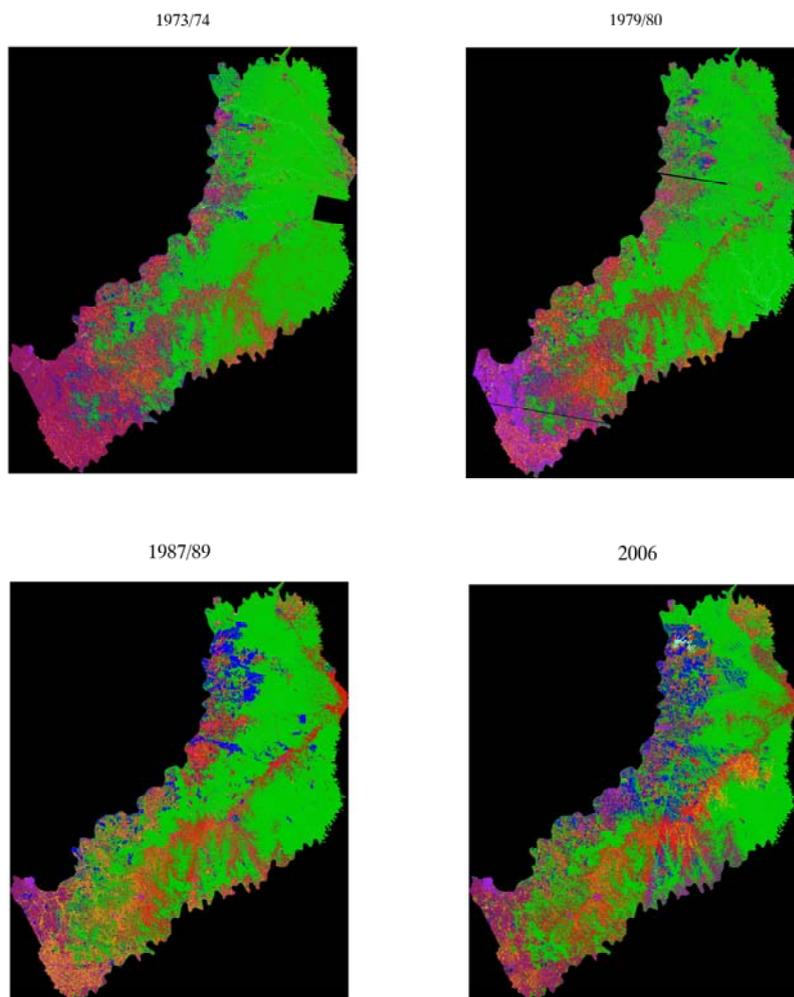


Fig 5: Classification of the four mosaics. Main class: ■ Forests, ■ Plantations, ■ Cultures

The area of main class based in the satellite images shows in the Table 1.

Table 1: Area of main class of land use and the change

		Mosaic				UMSEF
		1973/74	1979/80	1987/89	2006	2002
Bosque	Km2	16.997,67	17.260,26	16.846,85	14.852,79	12.124,60
	change (%)	//	1,05	-3,00	-11,80	
Plantaciones	Km2	2.845,75	2.540,04	2.482,78	2.963,23	2.016,01
	change (%)	//	-10,74	-2,25	19,35	
Cultivos perennes	Km2	1.764,67	1.744,10	3.513,77	2.809,79	
	change (%)	//	-1,20	101,40	-20,03	

Pasturas	Km2	2.623,81	497.94	1.693,18	2.408,67
	change (%)	//	-81,00	240,00	42,26
Uso mixto	Km2	3856.00	4201.47	3279.59	3.893,73
	change (%)	//	8,96	-21,94	18,73
Suelo desnudo	Km2	170.57	583.60	222.61	367,40
	change (%)	//	242,00	-61,86	65,01
Urbano	Km2	636.22	1976.59	629.82	960,01
	change (%)	//	210,70	-68,14	52,43

Actually, I am doing the verification of the satellites images analysis and I am analyzing the preliminary results of the first preview census of biodiversity.

Some conclusions

In general the departments within the three groups show a similar pattern of changing land use. The departments that were first colonized are losing their rural population, and there has been an increase in large-scale activities (forest plantations and pastures). The departments that were colonized latter have not experienced a large change in their rural population, but the land use has shifted toward more plantations and less croplands. Finally, the departments that have been colonized recently, and have a growing rural population are experiencing an increase in all land-use categories as forest is converted to human uses.

Although there has been a decrease in the rural population and an increase in forest cover at the province scale, these forests are mainly mono-specific plantations, which in ecological terms are very different from secondary forests.

These demographic and land use changes should have important implications for the conservation of the biodiversity of the Atlantic Forest. The information of census will be to determine how these changes are affecting the biodiversity by using ants, amphibians, and bird communities as bioindicators. We expect that this information will help us develop better conservation policy and management plans.

Academic activities

This project is part of my PhD thesis. During 2006, I have tomados three courses of graduate level for my PhD. These were:

- “Human demography and developments models”. Prof: Ms R. Bertoncello. Maimonides University- May, 15-20
- “Tools for regional analysis of interactions nature-society: Geographic Information Systems (ARC-GIS); Analysis of Satellite Images (ENVI) and Models of Dynamic Process (STELLA)”. National University of Tucumán. Tucumán, Argentina. June, 12-30.
- Scientific writing. Prof: PhD M. Rouges. CeIBA/University of Tucumán. June, 15-30.

I received a grant by my final project in the course ““Tools for regional analysis of interactions nature-society”. This work will publish how “Future scenarios for jaguar’s presence in Misiones” in the book “Dynamics models in ecology and environmental systems”, H. Grau (editor). Institute M. Lillo, University of Tucuman.

In addition, I have participated in the International Workshop “Valuation of Biodiversity in Agro-ecosystems”, for which, I have received a grants of the University of Buenos Aires.

Publications

Presentations of the project's results

- **Izquierdo, Andrea E.**; M. T. Aide and H. R. Grau. (2006) Changes in demographic and land-use patterns during the last 30 years in Misiones, Argentina. International Conference Ecology in an Era of Globalization: Challenges and Opportunities for Environmental Scientists in the Americas. Merida, Yucatan, México.
- **Izquierdo, Andrea E.** and C. de Angelo (in press). "Future scenarios for jaguar's presence in Misiones". *In: Dynamics models in ecology and environmental systems*, H. Grau (editor). Institute M. Lillo, University of Tucuman.
- **Izquierdo, Andrea E.**; M. T. Aide and H. R. Grau (in preparation). Implications of demographic changes for land use patterns in Misiones, Argentina.

Other publications

- **Izquierdo, Andrea E.** and H. R. Grau. (In press). "Agriculture adjustment, ecological transition and protected areas in Northwestern Argentina". (Journal of Environmental Management)