

Land Use Change in Mindelo Ornithological Reserve

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Abstract

Mindelo Ornithological Reserve was in 1957 the first protected area in Portugal for nature conservation, namely dunes and migratory birds. It was a mosaic of dunes, wet area, forest and agriculture fields. In the last decades it suffered a major building pressure. From 1958 to 2000 land with urban and industrial use grew from 4% to 26% of total area, 89 m² per day. Small coastal marsh reduced 70%. Previous use of built land was mainly forest. This area is densely built compared to the overall municipality. The period 1971-1990 had the higher increase in the number of constructions, largely for second homes. In the last decade, resident population is increasing at fast levels, turning this area into a dormitory fringe of Oporto. In the present it is an area with an undefined and ineffective protection status, but still a place with a significant natural and social heritage that should be protected.

1. INTRODUCTION

The Mindelo Ornithological Reserve (ROM - Reserva Ornitológica de Mindelo) is located in the coastal zone of the North of Portugal (figure 1), municipality of Vila do Conde, 20km from Oporto, occupying an area of around 6 million m².

In ROM we can find a mosaic of two small coastal lagoons with water coming from Silvares and Varziela streams, extensive dune areas, forest and agriculture fields. It is an important place for migratory birds, with 153 species already identified (MA 1999). It is also a significant refuge for amphibians (13 species) and reptiles.

It was legally created in 1957 (DGSFA 1957, 1959) in order to protect resident and migratory birds, forest and dunes, being the first area for nature conservation in Portugal. It is also said to be the first Ornithological Reserve in Europe (Oliveira 2002).

Santos Junior, professor in the Faculty of Sciences of the University of Oporto, proposed the creation of the reserve and initiated the bird banding in Portugal with the help from roleiros. Roleiros are turtle doves (*Streptopelia turtur*) catchers using nets with traditional methods unique in the world (Dias *et al.* 1995). To be a roleiro was considered a highly regarded social status until the late 1960's. In the period 1953-1989 about 20.000 doves were captured for ringing (Santos Júnior 1989).

Therefore a traditional activity of significant ethnographical value (dove hunting) was converted in a scientific activity, being the ROM created with the full support of all the landowners.

In the last decades many areas of the Reserve have been built for houses and industry, sand dune vegetation was removed, waste was dumped, fires took place and it suffered from coastal erosion. Bird banding has stopped in 1989. But the natural value of the place still remains. In the recent Coastal Zone Management Plan it was considered almost the only place with significant natural value in the region and “an important sanctuary for wildlife; to be protected at any cost” (MA 1999).

According to SNPRCN & CCRN (1987) and MA (1999), ROM's ecological characteristics and integration in Oporto urban area, makes it a privileged place for protection of endangered birds at the European level and also for environmental education and tourism.

2. METHODS

2.1 Land use change

The study of land use change in the last decades was done using aerial photographs (1958, 1968, 1976, 1989, 1995 and 2000), complemented with maps (1948, 1971, 1979 and 1976), bibliography, interviews and in site observation.

Land use was divided in Urban and industrial, Forest, Beach and dunes, Wet areas and Agriculture and vacant. Dune area was considered to be only sand dunes covered with no significant density of trees or shrubs.

Images and land use areas were analysed using AutoCAD software (Autodesk Inc.).

2.2 Population and housing

Population and housing data was collected and analysed for Azurara, Árvore and Mindelo, the three parishes where ROM is located (Figure 1), referred by AAM in the following paragraphs. Notice that this area is around 13000000 m².

Variations in resident population, households, dwellings and buildings were used to analyse demographic and building dynamics, complementing therefore land use data. Population and buildings density was also used to assert degree of urbanization.

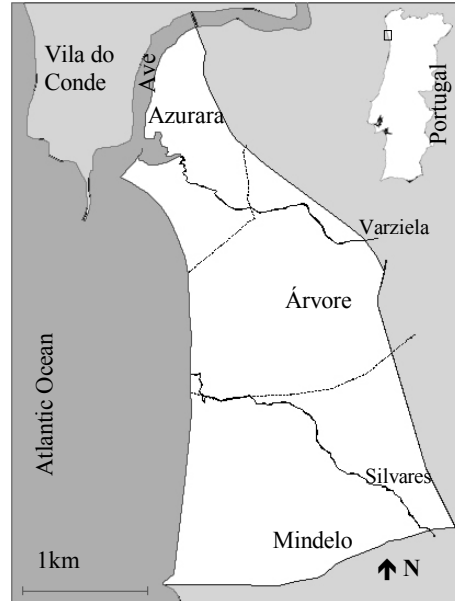


Figure 1: Location of Mindelo Ornithological Reserve.

The statistical data mainly came from the National Statistical Institute. Census 2001 results are still provisory (INE 2002).

3. RESULTS AND DISCUSSION

3.1 Land use change

Land use in ROM is presented in Figures 3 through 8 with legend in figure 2.

Area calculations for different land uses are presented in Table 1 and Figures 9 and 10.

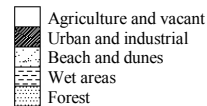


Figure 2: Legend for figures 3-8.

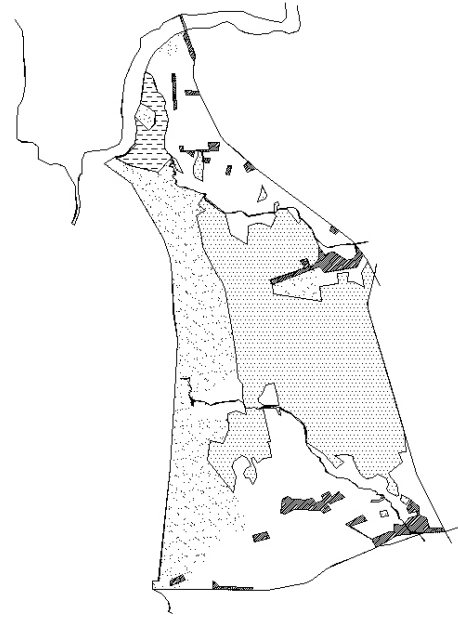


Figure 3: Land use in 1958.

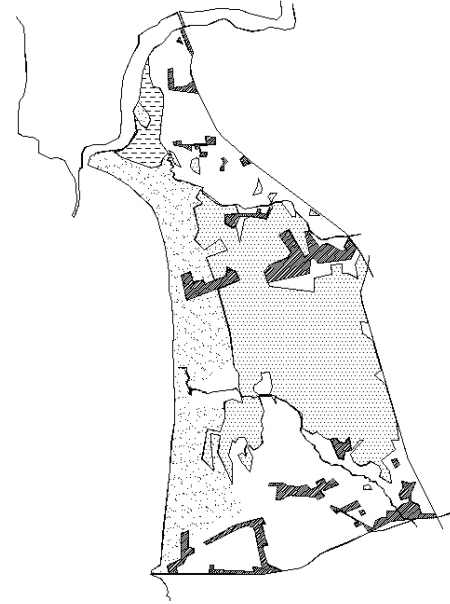


Figure 4: Land use in 1968.

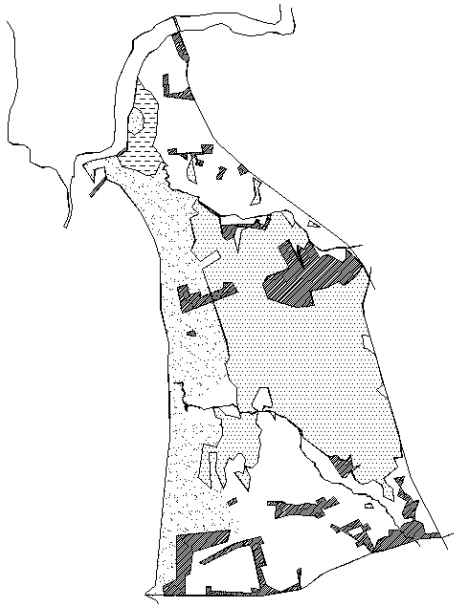


Figure 5: Land use in 1976.

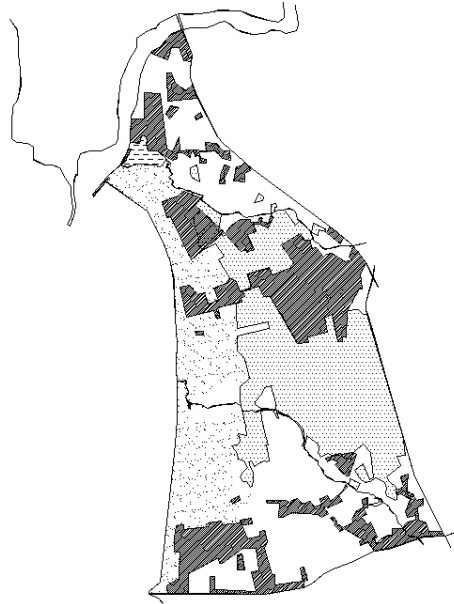


Figure 7: Land use in 1995.

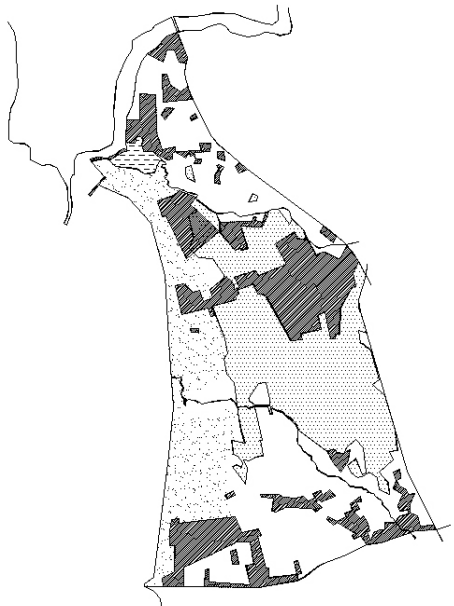


Figure 6: Land use in 1989.

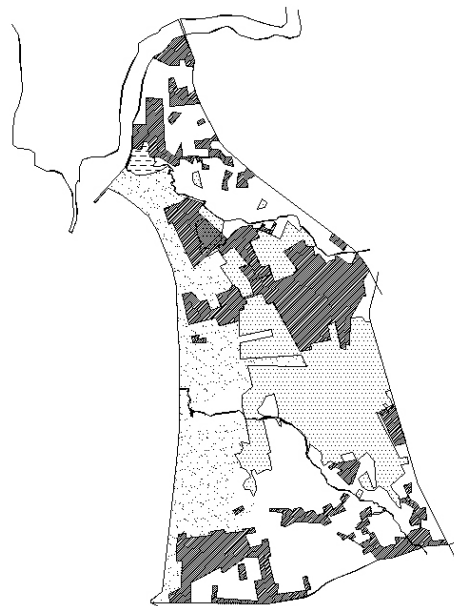


Figure 8: Land use in 2000.

Table 1: Land use areas expressed in 10^4 m^2 .

YEAR:	1958	1968	1976	1989	1995	2000
urban / ind.	23	46	68	135	137	160
forest	212	202	201	158	149	132
beach / dunes	148	133	128	110	115	117
Agric. / vacant	222	224	211	205	202	194
wet areas	15	15	13	7	5	5

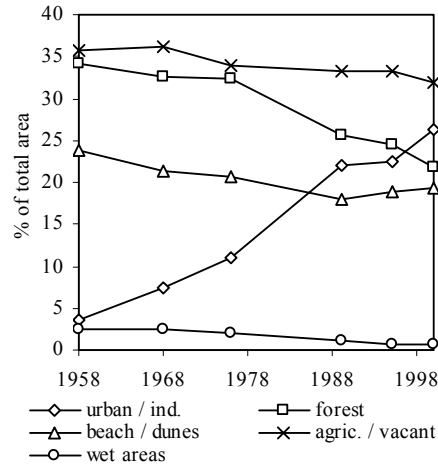


Figure 9: Changing in land use

There is an exponential increase in land with urban and industrial uses, going from 227339 m^2 in 1958 (3.7% of total area) to 1597418 m^2 in 2000 (26.3%), expanding more than 6 times, with an annual growth rate of 5%, 89 m^2 per day.

The growth is especially significant in the period 1976-1989 and since 1995. From years 1976 to 1989 there was an amount of 51.920 m^2 of land changing to urban and industrial uses every year (media), doubling the initial area.

Previous use of land changing to urban and industrial uses was mainly forest (around 50%).

Wet areas, consisting mainly in a marsh located near the Ave river estuary, had an decrease of around 70% between 1958 and 2000, mainly due to the building of a naval construction site in the period 1976-1989.

Land with forest use also had a significant decrease in the studied period (around 40%), especially areas located in Árvore (for construction) and dunes in Mindelo (sand extraction).

Sand dunes near the sea were used for construction of houses in Árvore and Mindelo, and also a camping site in Árvore.

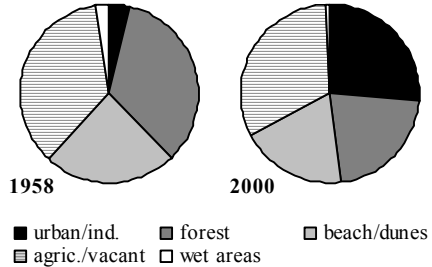


Figure 10: Land use in 1958 and 2000.

3.2 Population and housing

3.2.1 Population

Census data (CMVC 1991 & INE 2002) is presented in table 2 and figure 11. As we can see, Árvore was in 2001 the most populated parish, followed by Mindelo.

There was a steady increase in resident population in the last decades. AAM more than doubled the number of residents since 1950, with a relative increase superior to the municipality (67%). AAM is more densely populated than the overall municipality (see figure 11).

Table 2: Resident population from 1950 to 2001

YEAR	1950	1960	1970	1981	1991	2001
Árvore	1989	2614	2540	3177	3406	4261
Azurara	1261	1326	1370	1536	1794	2102
Mindelo	1641	1817	2025	2761	2859	3402
Vila Conde	44460	48806	53570	64402	64836	74391

Between 1991 and 2001 there was a 46% increase in the number of households living in AAM (while between 1981 and 1991 it was only 21%), in Vila do Conde 42% and in Oporto Urban area 23% (INE 2002).

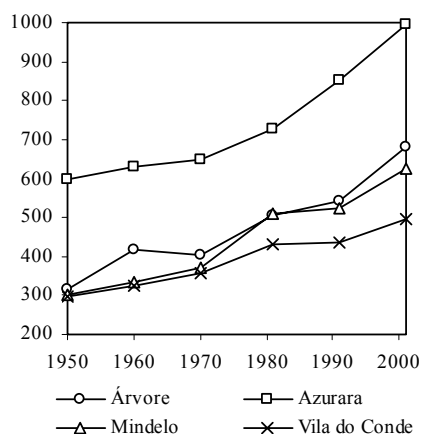


Figure 11: Population density from 1950 to 2001 (number of residents per square km).

3.2.2 Housing

Data for buildings and dwellings is presented in table 3 and table 4 (INE 2002).

The period 1971-1990 had the higher increase in the number of constructions per year (around 90 new buildings per year in AAM) with an annual growth rate of 5.5%.

Table 3: Number of buildings and date of construction.

BUILDINGS	< 1919	1919-1945	1946-1970	1971-1990	1991-2001
Árvore	1493	42	37	242	792
Azurara	558	51	50	73	237
Mindelo	1544	19	49	384	783
Vila do Conde	20395	1487	1600	4537	8393

Table 4: Total number of dwellings in 2001, and number of dwellings used as second home or seasonally.

	DWELLINGS	SECOND HOME
Árvore	2214	636
Azurara	986	234
Mindelo	2304	1131
Vila do Conde	31110	6654

Density of buildings in the three regions is much higher than for the overall municipality (260 and 137 buildings per km², respectively). Mindelo is the most densely built parish.

The percentage of second home dwellings is higher in AAM, comparing to the municipality media. In 2001 half the dwellings in Mindelo were used as second home or seasonally.

4. CONCLUSIONS

In the last decades there was a significant building pressure in the area of Mindelo Ornithological Reserve. Land with urban and industrial uses increased around 600% since ROM was created in 1957, representing nowadays 1/4 of total area. Conversion of area to urban use was especially significant in the period 1976-1989.

Annual growth of buildings has always been higher than resident population growth, mainly between 1971 and 1990. Data consistently indicates that building was largely for second homes and seasonal occupation, due to closeness to beaches and natural area. Building investments responded to this attraction but also helped promoting it (CMVC 1991).

Demographic data in the last decade for the three parishes that integrate this area (Árvore, Azurara and Mindelo) show a significant increase in the number of households. This indicates a strong tendency for ROM to attract population and become a dormitory fringe of Oporto.

In 1997 the building of a new road (IC1) connecting these area to Oporto considerably reduced time travel which certainly mostly contributed to this fact. Other major factor might also have been the growth in the industrial area located in Mindelo. Both this factors will continue to act in the following years since railway is being improved and there are major industries under construction.

According to CMVC (1991), land with urban and industrial uses is planned to grow from the present 26% to around 43%. These plans are under revision.

This tendency to urbanization caused significant environmental impacts since was not supported by environmental resources management, cares for urban design or infrastructures. Therefore we can conclude that the protection status created in 1957 was not appropriate for nature conservation and promotion of quality of life and needs urgent revision.

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