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ANTHROPIC PRESSURE ON THE CANTABRIAN COAST

J.C. Canteras Jordana[1], S. López Liñero[2] and Jaime Pardo Lledías[3]

ABSTRACT

The Autonomous Community of Cantabria is in the north of Spain, its northern border formed by the shores of the Cantabrian Sea. During the last few decades, socio-economic development has centred around the coastline, endangering natural ecosystems of great ecological value and renewable resources, as well as cultural values and traditional uses of land.

Cantabria has lost around 50 % of its estuary ecosystems, taking land from the sea for agrofishing, residential and industrial uses and for transport infrastructures, ignoring the values of biological productivity of these areas and their importance for the maintenance of traditional fishing grounds.

Today, fishing constitutes a secondary economic activity, with negative average annual rates in the catches of the main fisheries. These days, fishing ports are being transformed to house mainly recreational nautical activities.

The sediments of the Bay of Santander, San Martín de la Arena Estuary (Suances) and the Bay of Santoña have accumulated high concentrations of heavy metals.

In Cantabria, in the period between the year 2001 and the second term of 2003, 33828 new housing units have been built, 94.2 % on the coastal strip.

As for the transformation of the vegetation, the number of eucalyptus trees increased in the period from 1972 to 2000 by 72 %.

Key words: anthropic pressure, coastal management, contamination, overfishing, urban development.

1. INTRODUCTION

Cantabria is an Autonomous Community of the State of Spain of around 5300 km^2, situated in the north and bordered by the Cantabrian Sea, between 42º 46' and 43º 31' latitude north and 3º 9' and 4º 52' longitude west (see Figure 1).

[1] Profesor titular de Ecología, Universidad de Cantabria, canteraj@unican.es, Telf. 942201805, Avda. de los Castros, s/n. E.T.S.I. Caminos, Canales y Puertos, 39005, Santander, Spain.

[2] Licenciada en Ciencias del Mar, Fundación Leonardo Torres Quevedo, sira.lopez@alumnos.unican.es, Telf. 942201805, Avda. de los Castros, s/n. E.T.S.I. Caminos, Canales y Puertos, 39005, Santander, Spain.

[3] Licenciado en Biología, Fundación Leonardo Torres Quevedo, jaimepll@terra.es, Telf. 942201805, Avda. de los Castros, s/n. E.T.S.I. Caminos, Canales y Puertos, 39005, Santander, Spain.

Figure 1. Location of Cantabrian Community. The population of around 500000 inhabitants, is

concentrated on the coastal strip, this being the area which, in recent years, has undergone the most intense socioeconomic dynamism in the Community.

The absence of the environmental variable in the process of occupation and use of the coastal strip, of an integral coastal management and of any specific criteria for the planning of the coastal municipalities are seriously compromising the possibilities of sustainability of this coastal area.

This work describes: a) the heavy imbalance in the region of Cantabria between the coastal strip and the mountains inland, the two great natural areas which integrate and define this Autonomous Community and b) the consequences of the strong anthropic pressure placed on the coast as the socioeconomic space of the greatest interest for the development of Cantabria.

2. METHODOLOGY

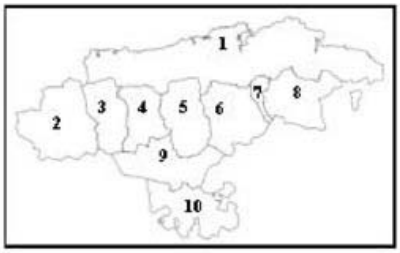
The socioeconomic development of Cantabria has been analysed and compared by means of a Principal Components Analysis (PCA). The ten natural local regions that integrate the Community of Cantabria have been considered as well as a set of 19 socioeconomic and demographic variables, as shown in Table 1, the data for which are drawn from the following sources:

- Municipal Statistical Indicators. Government of Cantabria. 1997.
- Economic Annual of Spain. 2003. La Caixa Studies Service.
- Economic Annual of Spain. 2004. La Caixa Studies Service.
- Socioeconomic and Labour Records of Cantabria 2002. Economic and Social Board of Cantabria.

The data handling has been carried out in keeping with the following steps: 1) obtaining the correlation matrix between all the variables, 2) calculating the eigenvalues of this matrix, their corresponding eigenvectors and Principal components (applying the *varimax* rotation*)* and , 3) extracting the coordinates or values for the observations, or local regions, in the axes or components obtained.

The anthropic pressure on the coastline was analysed using the following indicators: management of coastal areas, overexploitation of resources, contamination of estuaries by discharges, planning pressure and transformation of vegetation.

Table 1. Natural regions and variables considered in this study.



LOCAL AREAS

1. La Marina (Coastal Strip)
2. Liébana
3. Valley of Nansa
4. Valley of Saja
5. Valley of Besaya
6. Valley of Pas
7. Valley of Miera
8. Valley of Asón
9. Campoo
10. Valleys of South

VARIABLES

Average value of the area's municipalities:

1. Unemployment rate in 2003.
2. Percentage of housing units as first residence in 2001.
3. Percentage of empty housing units in 2001.
4. Population density in 2002.
5. Youth index in 1991.
6. Percentage of illiterates in 2001.
7. Percentage of university graduates in 2001.
8. Number of educational centres in 2001.
9. Growth rate in 2003
10. Number of bank branches in 2002.
11. Municipal budget in 2002.
12. Gross family income per inhabitant in 2002.

Mean comparative index of the importance of industry/commerce/hostelry in each local area, as a function of the tax on economic activities of the sector considered:

13. Mean industrial index in 2001.
14. Mean commercial index in 2001
15. Mean hostelry trade index in 2001.
16. Mean economic activity index in 2001, with respect to the total number of business and professional economic activities.

With respect to each local area:

17. Average distance from Santander airport.
18. Average smallest distance to a hospital centre.
19. Percentage of population in 2002.

3. RESULTS AND DISCUSSION

3.1 Regional Imbalance

The PCA performed reduces the information provided by the set of the 19 variables used to 3 axes or principal components which absorb 89.7 % of the total variance. Table 2 presents the load values of each variable for each of the three components. These values express the correlation of the variable with each component. Thus, variables with high values, close to 1, will have greater weight and will serve to interpret the significance of the principal components.

The first axis or component accounts for 50.66 % of the total variance and expresses the most important direction of the underlying variation in the set of information studied. The variables of most weight in this axis are as follows: bank branches, industrialisation index, commercialisation index, hostelry trade index, economic activities index and municipal budget.

All of these are variables which express or indicate aspects related with the economy of the local areas. A further two variables, population density and percentage distribution of the population per local area also have substantial weight in this axis, since the economy is more active in areas where the population is concentrated.

Table 2. Load values of the variables in each principal component.

Variables	Axis I	Axis II	Axis III
1. Unemployment rate	-0.485	-0.001	0.743
2. Percentage of housing units as first residence	-0.195	0.566	-0.741
3. Percentage of empty housing units	0.130	-0.661	0.128
4. Population density	0.942	0.302	-0.057
5. Youth index	0.391	0.822	-0.287
6. Percentage of illiterates	-0.278	0.182	-0.884
7. Percentage of university graduates	0.836	-0.234	0.349
8. Educational centres	0.703	0.340	-0.564
9. Growth rate	0.306	0.898	-0.021
10. Bank branches	0.967	0.129	0.078
11. Municipal budget	0.977	0.203	0.005
12. Gross family income	0.645	-0.234	0.717
13. Industrial index	0.915	-0.274	-0.024
14. Commercial index	0.964	0.241	0.016
15. Hostelry trade index	0.968	0.140	0.081
16. Economic activity index	0.977	0.154	0.035
17. Distance from Santander airport	-0.293	-0.708	0.412
18. Distance to a hospital centre	-0.079	-0.942	0.103
19. Percentage of population	0.936	0.271	-0.060

The first component thus allows the planning of the local areas of Cantabria as a function of their economic strength. Relative coordinates have been used, so that each axis comprises 100 percentage units, enabling the cartographic representation of the local areas, indicating with different shades the intervals of 10 percent. Thus, the first position corresponds to the interval between 90 and 100 % and the last position, the tenth, to the interval between 0 and 10 %.

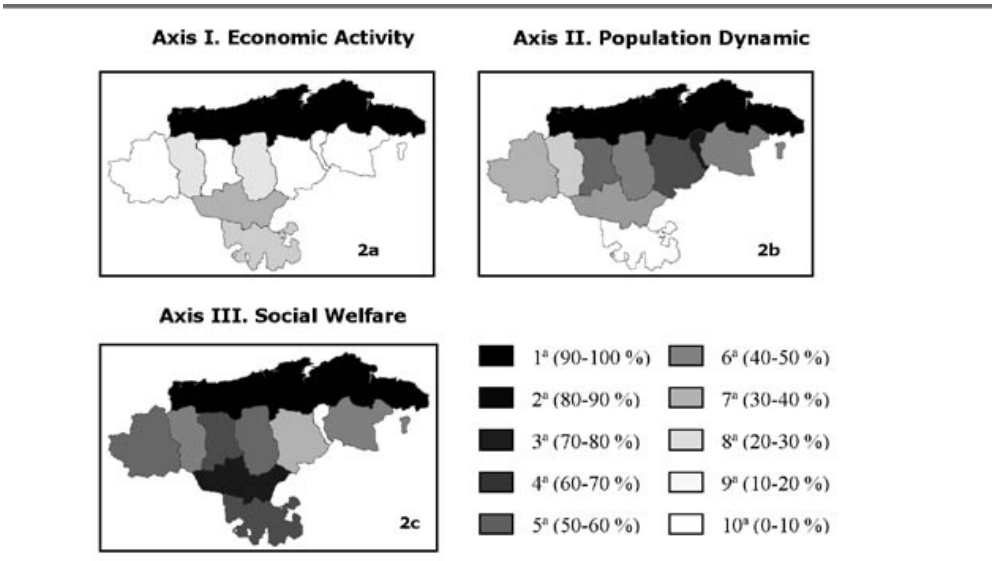
Using this system, Figure 2a shows the local regions of the Community of Cantabria as a function of their economic activity. The natural space of the coastal strip, or la Marina, stands out clearly from the rest of Cantabria, being the only one in the range between 90 and 100 %. The region of Campoo and that of the Valleys of the South are the next in economic importance, though at a considerable distance, Campoo being in seventh position, range 30 – 40 %, and the Valleys of the South in eighth position, range 20 – 30 %. The least favourable outlook is found in the set of regions which make up the intermediate valleys, Nansa and Besaya, occupying the ninth position, range 10 – 20 %, and the regions of Saja, Miera, Asón, Liébana and Pas are in the last position, in the range between 0 and 10 %.

The next axis or component accounts for 22.56 % of the total variance, outlining the second trend of variation in the set of natural areas of Cantabria. The variables which define this trend are of a dynamic demographic nature, such as the growth rate and the youth index. Two geographical variables also have some weight in this axis: that which represents the average distance from each region to Santander Airport (Parayas) and the distance to the closest hospital centre, variables which maintain a high negative correlation with demographics, since the older sector of the population is often found in the municipalities which are furthest from both the airport and the hospitals.

Figure 2b shows the cartographic representation of the regions of Cantabria in relation to the second axis or principal component which may be interpreted as demographic dynamics. The regions of la Marina and Miera are the most dynamic, the first being found in the range of 90 to 100 % and the second in the following range of 80 to 90 %, occupying respectively the first and the second position. The regions of Pas and Saja occupy the third position, range 70 – 80 %, and the fourth position, range 60 – 70 %, respectively. In an intermediate situation are the regions of Besaya and Asón, in fifth position (range 50 – 60 %) and Campoo, sixth (range 40 – 50 %). The last positions are occupied by Liébana, Nansa and the Valleys of the South, in positions seven (range 30 – 40 %), eight (range 20 – 30 %) and ten (range 0 – 10 %).

The third axis accounts for 16.52 % of the total variance. The variation tendency indicated by this axis is related with variables which point to degrees of social welfare: unemployment rate, percentage of housing units of first residence, percentage of illiterates and gross family income. The cartographic representation of the regions according to this axis of sociological variation is shown in Figure 2c. The best relative situation corresponds to the region of la Marina which ocupies the first position in the range of 90 – 100 %. The second position is occupied by Campoo, in the range of 80 – 90 %, followed by the regions of Saja, Valleys of the South, Besaya and Liébana, the first two occupying the third position, range 70 – 80 %, and the second two occupying the fourth position, range 60 – 70 %. In an intermediate situation of social welfare are the regions of Asón and Nansa which occupy the fifth position, range 50 – 60 %. The region of Pas is in seventh position, range 30 – 40 %, and the last position corresponds to the region of the Valley of Miera, in the interval between 0 and 10 %.

Figure 2. Cartographic representation of local regions of Cantabria according to the axes or principal components obtained from the PCA: axis I of economic activity (2a), axis II of population dynamics (2b) and axis III of social welfare (3c).



3.2 Main pressures on the coastline

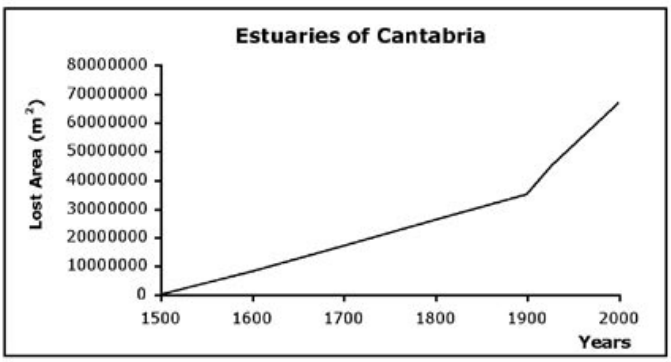
3.2.1 Management of coastal areas

The origin of the estuaries of Cantabria dates back to the last glaciation (Würm). During the Flandrian transgression, the surface area of the estuaries amounted to almost 112980500 m^2, lowering to 99305000 m^2 as a consequence of the fall in the sea level during the Postflandrian transgression. At present, the total surface area of the estuaries is 52082000 m^2, 52.4 % of the Postflandrian level, 89.4% of this reduction being due to anthropic causes and 10.6 % to the natural effects of sedimentation. (Rivas, 1991).

The human actions responsible for this occupation of areas of high ecological value have been landfills and barriers. According to data gathered by Rivas (1991), this process of occupation began in the 16th century, though most of the actions took place in the 18th and 19th centuries, with an average occupation rate of 173000 m^2/year (see Figure 3). This rate increased significantly until it reached a maximum value of 522000 m^2/year in the period between 1900 and 1925. After this date, the occupation rate fell slowly, though maintaining values greater than 300000 m^2/year.

The processes of landfilling and barrier-building have affected all of the estuaries of Cantabria, though with varying intensities. The greatest occupations in absolute terms have taken place in the Bays of Santander and Santoña, 21183000 m^2 and 11571000 m^2, while the most affected in percentage terms with respect to the original Postflandrian extension have been the estuaries of Brazomar, 91.3 %, Merón, 89.1 %, Tina Menor, 75.2 % and las Llamas, 73.9 %. The Bay of Santander has lost around 47.6 % and the Bay of Santoña around 37.8 %.

Figure 3. Lost area in the stuaries of Cantabria due to anthropic causes.



Land gained from the sea with these practices has been used for several purposes, the most important of which are agrofishing, urban expansion and those related with transport and communication.

The occupation rate of the estuaries is directly related with the demophoric development, a concept which takes in both demographic and economic development.

Thus, in the Bay of Santander, the Bay of Santoña and in the San Martín de la Arena Estuary (Suances), the occupation of sea areas has been very closely linked to the development and expansion of their ports.

The occupation and transformation of the Bay of Santander is a good example of the management of the estuary areas of Cantabria towards the end of the 20th century.

The first actions in the 20th century were related with barrier works connected with the installation of tide mill locks which exploited wave energy to transform primary materials.

The increasing activity of the port during the 18th and 19th centuries necessitated new docks and quays. The port thus became a key player in the urban development taking place around it. (Pozueta, 1984; Ureña y Gómez, 1984), requiring space for warehouses, offices, premises, commerces and housing. However, the various town planning projects which were implanted during this period were of limited spatial effect. At the end of the 19th century, only 398000 m^2 of the Bay (1.9 % of the total lost up to date) had been occupied.

The intensive processes of occupation of the Bay take place towards the end of the 19th century and the beginning of the 20th century, during which time 14470000 m^2 (65% of the total lost) were affected. The export of minerals to Europe during this period led to an economic boom which required space for the development of port activities, as well as urban and industrial land and land for communication infrastructures. The urban and industrial expansion took place mainly towards the west, while the southern part was used as a huge pot of iron mineral.

Industrial activity came to the fore in response to the crisis in mining, during the first quarter of the 19th century, establishing the pattern of occupation of sea lands in the bay up to the 1970s. During the second quarter of this century, the Albareda docks were built, the Raos docks were commenced and the new fishing port was completed, Puerto Chico being used henceforth for leisure boats. Thus, the eastward expansion of the port was finalised.

In the middle of the 20th century, the Santander regional development plan promoted the use of the bay as a communications node. The extension of the installations was continued (Maliaño and Raos docks) and Parayas airport was built on land claimed from the bay.

The industrial crisis of the 1970s led to the generation of leisure activity infrastructures (marinas) and the construction of great public works: the Santander – Torrelavega motorway, the amplification of Parayas airport and the Raos industrial estate, etc.

The lands claimed from the sea have been put to various uses (Rivas,1991). The largest space is occupied by grazing land (9162000 m^2; 41 %). The origin of this occupation lies in the huge landfills performed by the discharge of mineral in the Solia, Tijero, Boo and Cubas estuaries.

Transport infrastructures (4132500 m^2; 18.73 %) are represented by Parayas Airport, RENFE and the Raos docks. Industrial installations (3287000 m^2; 14.89 %) were located in the north-western arch of the bay, between 1883 and 1929. The land dedicated to housing is also of considerable magnitude (1153000 m^2; 5.22 %) and is located in the urban nucleus of Santander, Santiago district, Nueva Montaña and Somo.

It should be noted that 10.35 % of the area occupied by the bay is not the object of any use today, most of this being isolated areas with restricted tidal change. This area should be recovered.

The bay has lost around 50 % of its original space, being divided into two clearly differentiated areas as regards use and conservation, a direct consequence of the different degrees of development experienced by the surrounding municipalities. There is, on the one hand, the western end and the back of the bay, areas with the greatest concentration of mining activity and later of the most substantial industrial installations, with the consequent demand for labour, giving rise to the most densely populated urban nuclei (Camargo, Astillero, Santander) and a heavy deterioration in the landscape. On the other hand, there is the eastern end, in the part closest to the mouth which maintains, in contrast, a high degree of its original nature thanks to its lesser demographic and economic development.

3.2.2 Overexploitation of fishing resources

The evolution of the fishing sector in Cantabria is marked by the successive transformations that this activity has undergone on a nacional scale. Towards the end of the 1950s, the model of fishing exploitation in all of the Iberian Peninsula was that of a coastal and artisanal fisheries, and it was not until the end of the next decade when, thanks to the incorporation of industrial refrigeration in sea vessels, the process of change favouring the development of an industrial-scale fishing activity began. This new model of exploitation, sanctioned by the enactment of Law 147/1961, of December 23, on the renewal and protection of the fishing fleet, led to a substantial increase in the fishing effort, reflected in the greater number of vessels, the introduction of new more productive fishing techniques and the possibility of access to fishing grounds further from the coast (Ortega, 1996).

During the boom period of the modern fisheries between 1940 and 1965, the annual landings in the Cantabrian fishing ports were well over thirty million kilograms. In contrast with these good results, the excessive increase in activity together with the modern technologies incorporated in the sector led to problems of overexploitation of the traditional coastal fishing grounds.

These circumstances meant that fishing in Cantabria slipped into a period of decline, beginning in 1966 with up to a 50% reduction in the catches of the principal target species, the anchovy, and lasting up to the present.

The variations registered in the last years in the structure of the fishing catches in Cantabria's ports are a true reflection of this situation of exhaustion of the coastal fishing grounds. Thus, it can be observed that in the 1990s, none of the canning species comprised more than 30% of the total catch. This tendency continues at present, only the anchovy being among the most caught species, with a contribution to the total catch of only around 10 %.

As a representative example of the situation of overexploitation to which several of the main fishing grounds of Cantabria are subjected, the evolution in the catches of the following species will now be outlined: hake (*Merluccius merluccius*), bream (*Pagellus bogaraveo*), anchovy (*Engraulis encrasicholus*), and horse mackerel (*Trachurus trachurus*), according to the data provided by the Department of Cattle, Agriculture and Fishery of the Government of Cantabria.

Hake (*Merluccius merluccius***)**

The hake landed in Cantabria comes from trawlers, longliners and gillnetters working in Community waters off the coast of France (subareas VIIIa and VIIIb of the International Council for the Exploration of the Sea, ICES), and from fishing carried out in the Spanish continental shelf (subarea VIIIc of the ISEB). The main port for unloading is Santander.

The catches are few due to the overfishing. Several studies performed on the hake population of the Cantabrian Sea point out that this species is subjected to heavy overexploitation (see Figure 4).

Sea Bream (*Pagellus bogaraveo***)**

The catches come mainly from subarea VIIIc. The ports of San Vicente de la Barquera and Santander are those that handle most of the sea bream.

Sea bream fishing plays an important role thanks both to its high economic interest and the seasonality of the fishing, since it allows the fleet to remain active during the winter months, until the anchovy and tunny-fish season begins.

The catches of this especies have decreased gradually, practically since the first records were taken, coinciding with the change in the fishing gear from pole and handline to the longliner, which is more efficient (see Figure 4). This great decline shows a clear syndrome of overfishing, since the effort of the fleet to catch this species has not diminished, while it may be said that bream fishing no longer exists in the Cantabrian Sea.

Anchovy (*Engraulis encrasicholus***)**

This is a clearly seasonal fishery taking place between the months of March and July. Most of the anchovy landing is done in Santoña which boasts an important canning industry. The catches of this species come from the Gulf of Biscay (Subarea VIIIb and VIIIc of the ICES).

The largest catch was registered in 1965, with a total of 27000 tonnes (see Figure 4). Since this year, catches have fallen sharply coinciding with the increase in the number of vessels.

There was an increase in the fishing effort after 1975 with the incorporation of sonar to the fleet, which led to a rise in catches, though to a far lower degree than the great catches of 1965. This fact coincided, some years later, with a new fall in catches, registering in 1982 the minimum of the whole historic series, which led to a parallel reduction in the fleet and a reduction in the fishing area which, for all of the Cantabrian Sea, was limited to the inner part of the Gulf of Biscay (Junquera, 1986; 1991).

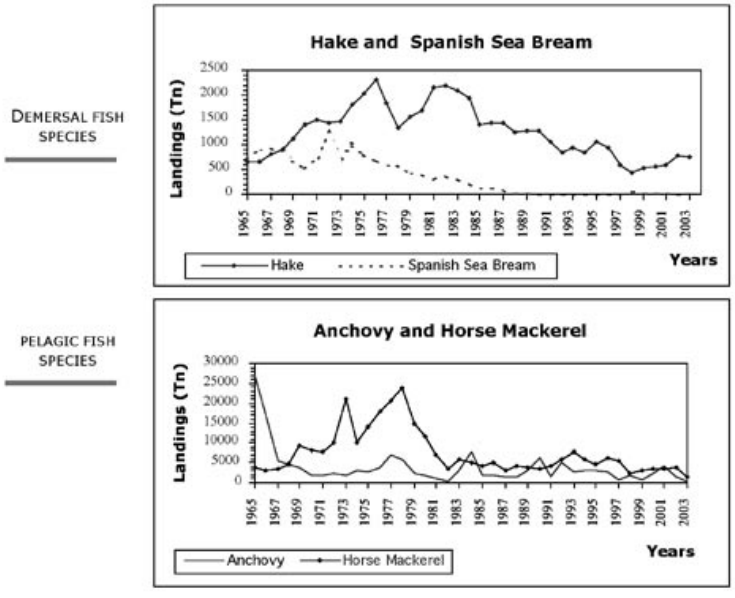
This series has been followed by reasonable catches, with averages of 7000 tonnes, with other clearly unsatisfactory ones, of 2000 tonnes, in almost regular cycles until 1991. Since then the intakes have fallen gradually, with the exception of the year 2001 with almost 4500 tonnes. These low catches are originated by low recruitments.

Horse mackerel (*Trachurus trachurus***)**

The biggest catches come from division VIIIc though they are also present in subareas VIIIa and VIIIb.

The initial series show poor data on horse mackerel catches as regards landings, while a tendency to increase is noted after 1968, reaching a maximum in 1978 of around 24000 tonnes, then followed by a sharp fall until establishing an average balance of below 5000 tonnes (see Figure 3). This fall is probably due to the fish discarded by the trawlers on their return to the ports of disembarkment, to economic factors or to the abundance of the target species, hake.

Figure 4. Evolution of catches of fishing species in situation of overexploitation.



The biggest catches of this species are those obtained by purse-seines making up 90% of the total caught, while hook-fishing and gillnets account for the remaining 10 %. The ports of Santander and Santoña are the main ports of disembarkment.

Horse mackerel is, after the anchovy, the species with the biggest catches of all of the fleet of the Cantabrian coast, but in recent years, the widespread decline in numbers indicates that this is an overexploited species.

3.2.3 Discharges in Estuaries

The concentration of the population and of industry in the region of la Marina, together with the fact that the rivers are used for the evacuation of wastewaters, means that liquid discharges reach the coast through the estuaries.

One indication of the pressure borne by the coast can be observed in Table 3, where the total number of equivalent inhabitants per basin in the Community of Cantabria is shown. The coastal zones most affected are the Suances Estuary and the Bays of Santander and Santoña, in which the contamination of waters and sediments is critical in certain areas.

Table 3. Equivalent inhabitants per basin.

Basins	Population inhabitants	Industry Equivalent inhabitants	Total equivalent inhabitants
Agüera-Castro Urdiales	24151	26674	50825
Asón-bahía de Santoña	75324	36448	111772
Miera-bahía Santander	313298	362647	675945
Pas-Pisueña	39937	33218	73155
Saja-Besaya	124705	262201	386906
San Vicente de la Barquera	19891	4225	24116
Nansa	3639	0	3639
Deva	9142	1583	10725
Ebro	21053	29703	50756
Duero	1626	3560	5186

Source: Consejería de Medio Ambiente, Gobierno de Cantabria.

Estuary of Suances

The basin of the Saja-Besaya system concentrates a total of 386906 equivalent inhabitants, mainly in the area of Torrelavega, of which 68% is attributed to industrial activity. Most of these wastewaters are finally gathered by the flow network and are taken out to sea through the San Martín de la Arena Estuary (Suances).

The indicators which best reflect the state of quality of the estuary are the concentration of oxygen dissolved in water and the concentration of heavy metals in sediment. The demand for oxygen, both chemical and biological, of the discharges received exceeds the capacity for reoxygenisation, leading to situations of anoxy in the area of la Punta del Hornillo, where the entrance of seawater with oxygen saturation values relieves the critical situation, Figure 5. (Infrastructure and Ecology, 2000).

Industrial discharges have caused heavy metals to accumulate in the estuary sediments, especially lead, zinc, mercury and cadmium. Figure 5 shows the concentration of these metals in various areas of the estuary. In order to evaluate this data, Table 4 presents the levels of action, as threshold values, of the CEDEX (1994) corresponding to non-contaminated, moderately contaminated and highly contaminated sediments. The stretch of the estuary between the Hinojedo dock and the fishing port of Suances shows sediments which fit into the category of highly contaminated, with concentrations of mercury, cadmium, zinc and lead of over 28 ppm, 90 ppm,1600 ppm and 3400ppm. (Infrastructure and Ecology, 2000).

Figure 5. Environmental quality of Suances estuary through two indicators: the first one relative to the mass of water [concentration of dissolved oxygen (mg/l)] and the second sediment [concentration of heavy metals (ppm)].

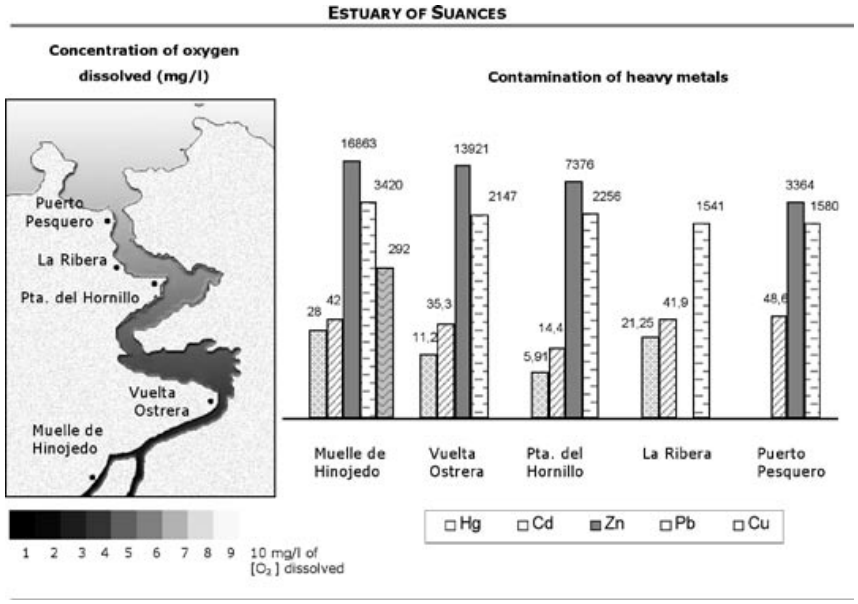


Table 4. Threshold values of heavy metal concentration for the characterisation of marine sediments.

marine sediments.

	Sediments		
Metal, ppm	No contaminated Action level 1	Moderately contaminated	Highly contaminated Action level 2
Mercury	< 0.6	Entre 0.6 y 3.0	> 3.0
Cadmium	< 1.0	Entre 1.0 y 5.0	> 5.0
Lead	< 120	Entre 120 y 600	> 600
Copper	< 100	Entre 100 y 400	> 400
Zinc	< 500	Entre 500 y 3000	> 3000
Chrome	< 200	Entre 200 y 1000	> 1000
Arsenic	< 80	Entre 80 y 200	> 200
Nickel	< 100	Entre 100 y 400	> 400

Bay of Santander

The Miera basin contains 675945 equivalent inhabitants, concentrated in the Bay of Santander, industrial activity being responsible for 54 % of the wastewater discharge.

The Integrated Sewage Plan for the Bay of Santander initiated in 2002 deals with most of the wastewater, which is taken to the sewage plant of San Román de la Llanilla to be later discharged into the neritic medium in the area of Virgen del Mar. The most appropriate indicator of the quality of the bay at this point has been considered to be the concentration of heavy metals in the sediments.

Table 5 shows the average values recorded in the area of Raos, mainly intertidal. The concentrations of zinc and lead exceed action level 1 and that of mercury even surpasses action level 2, highlighting the high levels of contamination of the sediments of the Bay of Santander. (Revilla et al., 2000).

Table 5. Concentration of heavy metals in the area of Raos, Bay of Santander.

marine sediments.

	SEDIMENTS		
Metal, ppm	No contaminated Action level 1	Moderately contaminated	Highly contaminated Action level 2
Mercury	< 0.6	Entre 0.6 y 3.0	> 3.0
Cadmium	< 1.0	Entre 1.0 y 5.0	> 5.0
Lead	< 120	Entre 120 y 600	> 600
Copper	< 100	Entre 100 y 400	> 400
Zinc	< 500	Entre 500 y 3000	> 3000
Chrome	< 200	Entre 200 y 1000	> 1000
Arsenic	< 80	Entre 80 y 200	> 200
Nickel	< 100	Entre 100 y 400	> 400

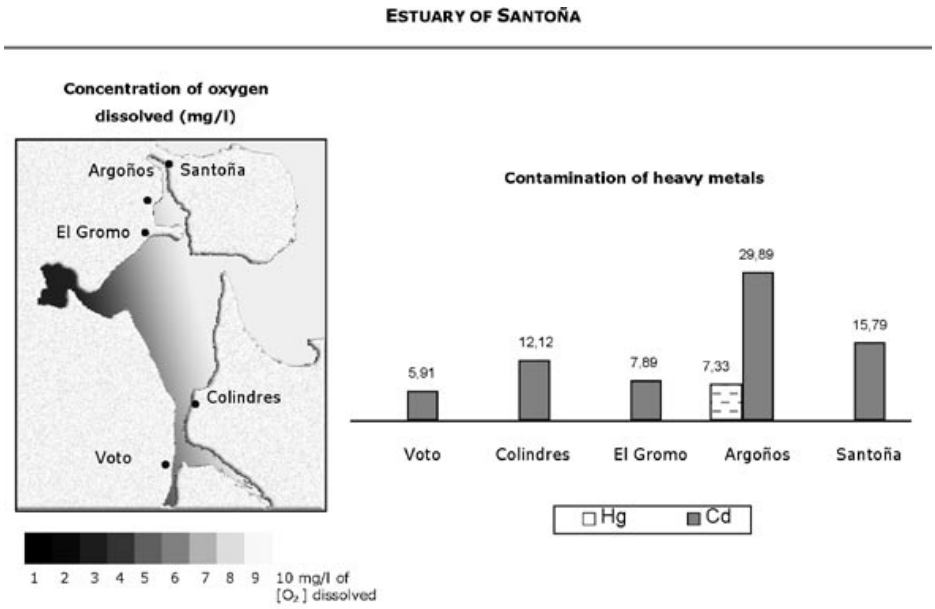
Estuary of Santoña

The Asón basin has a total of 111772 equivalent inhabitants, 32 % of which are due to industrial activity. The concentration of oxygen dissolved in water and the concentration of heavy metals in the Bay of Santoña synthesise the anthropic pressure on this area of the coast.

The concentration of oxygen shows a marked zonal distribution (see figure 5) with average annual values of under 3.9 mg/l in the innermost areas and values between 4 and 5.9 mg/l in the main channels. The highest values are obtained in the wetland marshes of the Dueso due to an intense photosynthetic activity. In the Escalante Estuary, values of under a 1 mg/l of oxygen are obtained in summer, Pérez et al. (2000).

The concentration of heavy metals in sediment shows zones in the estuary contaminated by mercury and cadmium, Figure 6. The Boo Estuary (Argoños) presents average mercury concentration values of 7.33 ppm, exceeding action level 2 and reveals sediments highly contaminated by this metal. The cadmium concentrations exceed action level 1 in all of the zones analysed, and action level 2 in the following zones: Voto, Colindres, El Gromo, Boo Estuary (Argoños) and Santoña. (Villasante, 1996; Canteras et al., 2000).

Figure 6. Environmental quality of Santoña's estuary through two indicators: the first one relative to the mass of water [concentration of dissolved oxygen (mg/l)] and the second sediment [concentration of heavy metals (ppm)].



3.2.4 Urban development pressure and modification of the landscape

In the last few decades, the increasing spread of tourism, the Cantabrian motorway, the policies of the European Union in agriculture sector and the greater socioeconomic expectations of the region of la Marina have meant that the use of land has tended to move towards residential purposes. This developmental pressure and the transformation of the vegetation through massive plantations of eucalyptus and pine trees, have given rise to a true transformation of the landscape of the coastal strip.

Due to their adjacency to both urban and rural nuclei, the traditional spaces formed by meadows and hill terraces have been the lands most affected by building processes either in the form of single housing units or housing estates. In some areas, land has also been occupied for industrial use and for infrastructures. The result is that three different zones can be distinguished in la Marina according to the different type of anthropic pressure:

1. Very high pressure coastline: axis Santander-Camargo-Astillero in the north and west of the Bay of Santander and the Santander-Torrelavega corridor.

2. High presure coastline: in the eastern zone, municipalities of Castro Urdiales, Laredo, Colindres, Santoña and Noja.

3. Medium pressure coastline: in the western zone, municipalities of Santillana de Mar, Comillas, San Vicente de la Barquera.

An indicator of the city-plaining pressure is the evolution of urban land in coastal municipalities such as Noja and Piélagos.

The municipality of Noja covers 9.2 km^2. The urban land detailed in the Urban Development Plan of 1990 occupies a surface of 40.9 %, constituting an increase with respect to that described in the previous plan of 1979 of 113 %.

The municipality of Piélagos covers a surface of 88.6 km^2. In the Urban Development Plan of 1985 the percentage of urban land was 6.08 %, increasing to 7.29 in the Plan of 1993, but distributed extremely unevenly. The greatest proportion corresponds to nuclei on the coastal fringe, especially in Puente Arce, Liencres and Mortera, where urban land has increased by 144 %, 85.5 % and 72.8 % respectively.

The number of new housing units built is another indicator of the strong pressure of urban development on la Marina with respect to the other regions of the Community of Cantabria. From the year 2001 to the second term of 2004, the number of new housing units built in Cantabria has been 33828, of which 31857 have been erected in la Marina, that is 94.2 %. (Colegio Oficial de Aparejadores y Arquitectos de Cantabria, 2004). The region of the Valley of the Besaya ocuppies the second place with 2.2 % and la Liébana is in third place with 1.5 % of the housing units built in this period of time.

As for the transformation of the forests, the surface occupied by single-species masses of repopulation corresponding to eucalyptus and radiata pine trees is 9.6 % of the total forested area of Cantabria, concentrated almost completely in la Marina, the increase in the number of eucalyptus tress in the period from 1972 to 2000 being 72 %. (Cantabria Forestry Plan, 2003).

4. CONCLUSIONS

The Community of Cantabria presents a pronounced regional imbalance. The region of la Marina constitutes the most important economic and demographic area.

This unequal regional development has led to a strong anthropic pressure on the coastal strip which has led to:

- The loss of natural spaces of a high ecological value such as estuaries, which have been reduced by 50 %.

- The contamination of the coast, especially in areas where the population and industry are concentrated: Bay of Santander, Bay of Santoña and San Martín de la Arena Estuary. The heavy metals accumulated in the sediments give high concentrations of mercury, cadmium and lead in certain areas.

- The overexploitation of fishing resources, fishing being at present a secondary activity.

• A modification of the coastal landscape, as a consequence of an accelerated process of urban development on traditional meadow and hill terrace lands, and the substitution of mixed autochthonous woods by single-species plantations of rapid growth.

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APENDICE: LA PRESIÓN ANTRÓPICA EN EL LITORAL DE CANTABRIA

RESUMEN

La Comunidad Autónoma de Cantabria se sitúa en el norte de España, limitando con el mar Cantábrico. En las últimas décadas el desarrollo socioeconómico se ha polarizado hacia la costa, poniendo en riesgo ecosistemas naturales de alto valor ecológico, recursos renovables, así como, valores culturales y tradicionales de utilización del suelo.

Cantabria ha perdido aproximadamente el 50 % de sus ecosistemas de estuarios, ganándose suelo al mar para usos agropecuarios, residenciales, industriales y para infraestructuras de transporte, ignorando los valores de productividad biológica de estos espacios y su vinculación con el mantenimiento de las pesquerías tradicionales.

La pesca constituye hoy una actividad económica residual, con tasas anuales medias negativas en las capturas de las principales pesquerías. Los puertos pesqueros son transformados para albergar esencialmente actividades náutico-recreativas.

Los sedimentos de la bahía de Santander, ría de San Martín de la Arena (Suances) y de la bahía de Santoña han acumulado altas concentraciones de metales pesados.

En Cantabria, en el período comprendido entre el año 2001 y el segundo trimestre de 2003, se han construido 33828 viviendas nuevas, el 94,2 % de las mismas se han llevado a cabo en la franja costera.

En cuanto a la transformación del tapiz vegetal, el incremento del número de ejemplares de eucaliptos en el período entre 1972 y 2000 ha sido del 72 %.

Palabras clave: presión antrópica, gestión costera, contaminación, sobrepesca, desarrollo urbano.

INTRODUCCIÓN

Cantabria es una Comunidad Autónoma del Estado Español de unos 5300 km2, localizada al norte y limítrofe con el mar Cantábrico, entre los 42º 46' y los 43º 31' de latitud norte y los 3º 9' y 4º 52' de longitud Oeste. Su población, de algo más de 500000 habitantes, se concentra en la franja costera, siendo esta zona la que en las últimas décadas ha experimentado el mayor dinamismo socioeconómico dentro de la Comunidad.

La ausencia de la variable ambiental en el proceso de ocupación y utilización de la franja costera, de un enfoque de gestión integral de la costa y de unos criterios específicos de ordenación para los municipios costeros están poniendo en riesgo las posibilidades de sostenibilidad de este espacio litoral.

Se presenta en este trabajo: a) el fuerte desequilibrio regional existente en Cantabria entre la Franja Litoral y la Montaña, las dos grandes comarcas naturales que integran y definen a esta Comunidad Autónoma y, b) las consecuencias de la fuerte presión antrópica que recibe el litoral como espacio socioeconómico de mayor interés para el desarrollo de Cantabria.

METODOLOGÍA

El diferente grado de desarrollo de las diez comarcas naturales que integran la Comunidad de Cantabria ha sido estudiado a través de 19 variables sociales, mediante la obtención de los valores propios de la matriz de correlación entre todas las variables y su análisis en componentes principales. Las representaciones cartográficas se han realizado obteniendo las coordenadas relativas sobre cada componente extraído.

La presión antrópica sobre el litoral fue analizada mediante los siguientes indicadores: gestión de espacios litorales, sobreexplotación de recursos, contaminación de rías y modificación del paisaje costero por la presión urbanística y modificación del tapiz vegetal por plantaciones monoespecífica de rápido crecimiento.

CONCLUSIONES

La información aportada por el conjunto de las variables estudiadas se puede reducir a tres componentes o ejes que marcan las tendencias principales de variación en el desarrollo social de las comarcas de la Comunidad de Cantabria. La primera tendencia se refiere al desarrollo económico, la segundo se asocia a la dinámica poblacional y la tercera al grado de bienestar social.

Cada eje da lugar a una ordenación de las comarcas, obteniéndose de esta manera las diferencias relativas según las tendencias de variación. La ordenación según la pujanza económica sitúa a la Marina como el espacio geográfico de mejor valor por los indicadores económicos. Hay un marcado desequilibrio regional entre la Marina y las restantes comarcas. La zona costera es la de mayor densidad de población, concentra al 86,68 % de la misma, proporciona mayores oportunidades y dispone de las mejores infraestructuras de comunicación, mayor número de oficinas bancarias y donde se ubica las principales industrias de la Comunidad. Actúa como foco de atracción del resto de las comarcas, especialmente de la de los valles intermedios, Nansa, Saja, Besaya, Pas Miera y Asón.

El segundo eje se relaciona con la dinámica poblacional, ordenando las comarcas según la tasa de crecimiento y el índice de juventud. Esta ordenación marca diferencias menos acusadas entre las comarcas. El mayor dinamismo demográfico coincide con la zona donde hay mayor actividad económica y mayores posibilidades de desarrollo, la Marina. Los Valles del Sur y las comarcas del Nansa y de la Liébana ocupan las últimas posiciones, consecuencia de las tasas negativas de crecimiento y de su población envejecida.

Por último, el tercer eje vuelve a situar a la Marina como el espacio geográfico de la Comunidad de Cantabria con los mejores índices en cuanto a bienestar social. Las mayores perspectivas económicas determinan que la media de la tasa de paro de sus municipios sea la menor de toda la Comunidad. En la Marina se tiene también el nivel de instrucción más alto, y la mayor renta bruta familiar disponible por habitante.

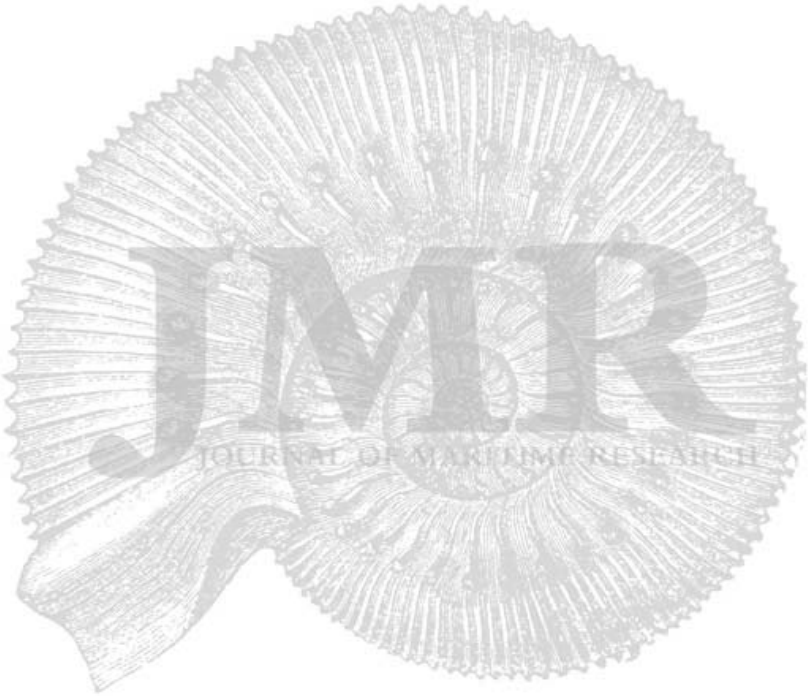
Este desigual desarrollo regional ha supuesto una fuerte presión antrópica sobre la franja costera que se ha traducido en:

• La pérdida de espacios naturales de alto valor ecológico como los estuarios, reducidos a su 50 %.

• La contaminación del litoral, especialmente en las zonas donde se ha concentrado la población y las industrias: bahía de Santander, Bahía de Santoña y ría de San Martín de la Arena. Los metales pesados acumulados en los sedimentos alcanzan, en determinadas zonas, elevadas concentraciones de mercurio, cadmio, zinc y plomo.

• La sobre explotación de recursos pesqueros, constituyendo hoy la pesca una actividad económica residual.

• Una modificación del paisaje costero, consecuencia de un acelerado proceso de urbanización sobre suelos tradicionales de mieses y terrazgos de monte, así como de la sustitución de los bosques mixtos autóctonos por plantaciones monoespecíficas de rápido crecimiento.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