

**CASTILLO DE DOÑA BLANCA:
PATTERNS OF ABUNDANCE IN THE ICHTHYOCOENOSIS
OF A PHOENICIAN SITE FROM THE IBERIAN PENINSULA**

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ABSTRACT: The paper reports on the fish assemblage from the oldest phoenician site thus far known in the Iberian Peninsula. An sample of almost 2.500 remains has been analyzed from a square excavated during 1986 (Fo. 30) covering a time span of more than two hundred years. A highly diversified fauna, with almost 50 taxa, has been found. The analysis detects environmental and cultural reasons behind the taxocenosis. Both natural and anthropic agents produce two somewhat related sets of abundance patterns of the taxa which we have been able to explain to a certain extent.

KEYWORDS: FISH, BONES, IBERIA, PHOENICIAN, ABUNDANCE, DISTRIBUTION, MODELS

RESUMEN: El trabajo comenta la asociación íctica detectada en lo que parece ser el más antiguo asentamiento fenicio conocido hasta ahora en la Península Ibérica. Una muestra de casi 2.500 restos, procedentes de una trinchera (Fo. 30) excavada en 1986 y cubriendo un lapso temporal de más de dos siglos ha sido analizada. En ella aparece una fauna altamente diversificada con casi 50 taxones. El estudio revela la existencia de agentes culturales y ambientales como responsables de la formación de la taxocenosis. Ambos tipos de agentes producen dos patrones de abundancia taxonómica interrelacionados que hemos sido capaces de explicar en no poca medida.

PALABRAS CLAVE: PECES, HUESOS, IBERIA, FENICIO, ABUNDANCIA, DISTRIBUCION, MODELOS

INTRODUCTION

Castillo de Doña Blanca, the oldest phoenician site thus far excavated in the Iberian Peninsula, is a tell of 200 x 300 m located on a former shoreline of the Bay of Cádiz built by the estuary of the Guadalete river (Figure 1). Discovered in 1923, its first excavation dates from 1979, with regular campaigns following in the years 1981-1983, 1986 and 1987. In 1984 a 2.4 km² necropolis lying next to the site was unearthed and excavated for the first time.

Chronologically, the occupation of Castillo de Doña Blanca (CDB) starts just at the beginning of the 8th century B.C. and ends with the 3rd century B.C. The city, with its important harbour, seems to have known a period of maximum commercial activity with the beginning of the 7th century B.C.; at that moment, the people from Doña Blanca seem to have been in close contact with the Tartessian cultures of southwestern Andalusia. The reasons for abandoning the city are still obscure. It seems that the filling up of the bay brought about by the continuous flow of sediments from the river Guadalete rendered the harbour useless by the 4th century, but there are also indications of violence at this moment in the impressive defensive walls, the first known work of military engineering from the western mediterranean (Ruíz Mata, 1988).

Two cultures coexisted at CDB for when the phoenicians arrived there were tartessian peoples settled in the tell and in neighbouring villages. The dominating cultural influence at CDB is, nevertheless, phoenician. As a matter of fact, some of the excavators believe that the city corresponds to what old greek and roman texts identify as "Gadir" the oldest urban settlement in the Iberian Peninsula (Ruíz Mata, verb. comm.).

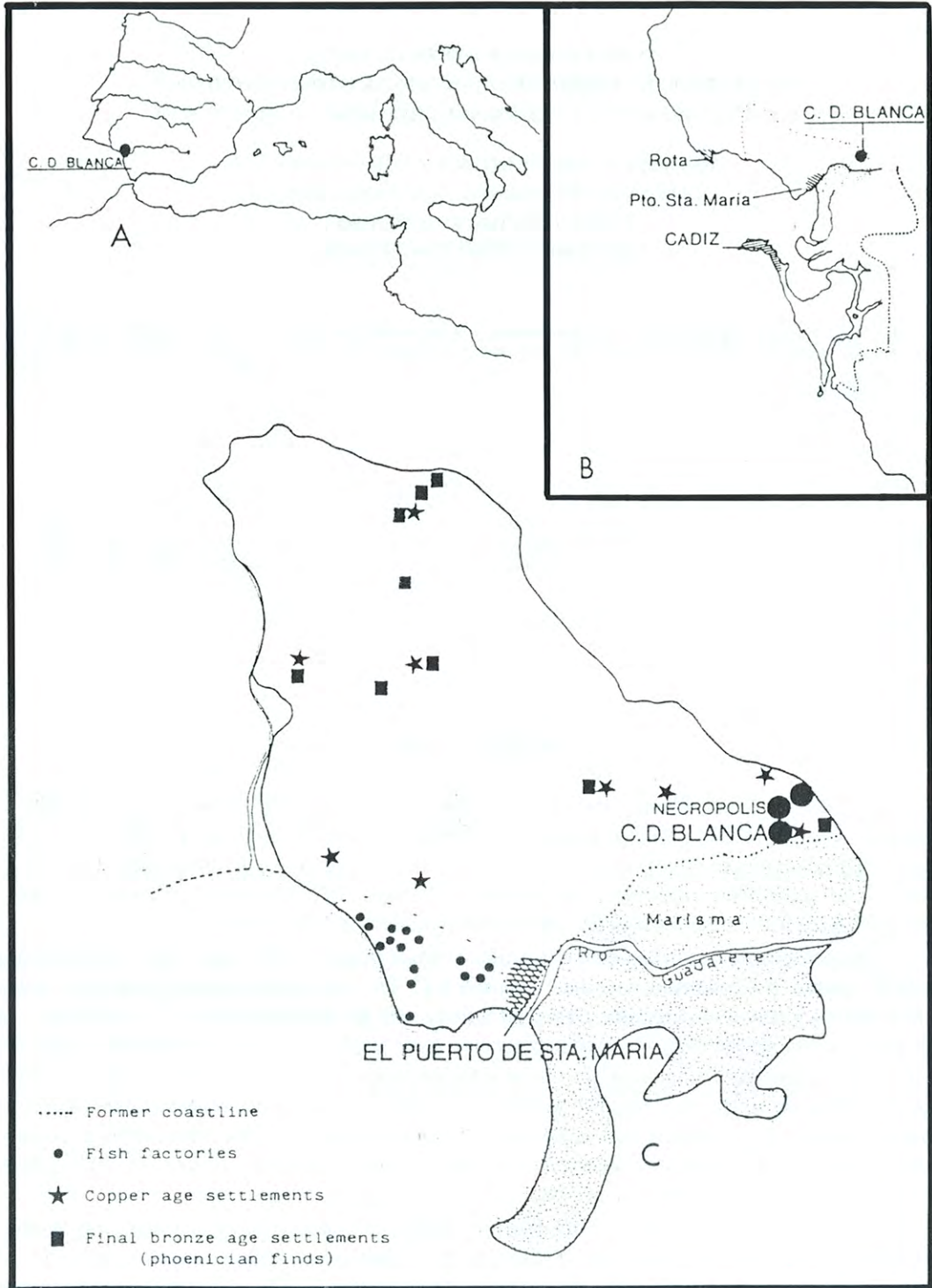


FIGURE 1. A: Geographic location of Castillo de Doña Blanca; B: Geographic location of Castillo de Doña Blanca the Cádiz bay; C: Archaeological sites within the municipality of El Puerto de Santa María (modified from Ruíz Mata, 1988).

In the present paper we discuss the main results from the analysis carried out on the fish remains. A more comprehensive treatment of this same sample, as well as data on other biological and geological material, is provided in Roselló & Morales (in press).

MATERIAL AND METHODS

The remains of fishes all come from the 1986 campaign. In this year a 4 x 4 m stratigraphic trench (Fo. 30) was excavated. 19 levels have been recognized ranging from the beginning of the 7th century B.C. until the end of the 5th or beginning of the 4th century B.C. (Figure 2). The upper levels (IV - I) are all of uncertain dating and archaeologically sterile. Fo. VII is a pavement in the transition from the 6th to 5th centuries and is devoid of fauna. Also sterile is level Fo. XI. The approximate dates for the remaining levels with the amount of sediment floated and the botanical taxa detected is shown in Chart 1.

LEVEL	YEARS	SEDIMENT FLOATED & SIEVED (TONNES)	ASSOCIATED PLANTS
Fo. VIII	550 - 500 A.C.	45.0	<i>Hordeum</i> sp., <i>Vicia</i> , <i>Vitis vinifera</i> , <i>Triticum</i> sp., <i>Olea europaea</i> , <i>Cicer arietinum</i>
Fo. IX	575 - 550 B.C.	45.0	<i>V. vinifera</i> , <i>Triticum</i> sp., Leguminosae, <i>Vicia (faba)</i> <i>minor</i> , Gramineae, Convolvulaceae
Fo. X	600 - 575 B.C.	135.0	<i>V. vinifera</i> , <i>Triticum</i> sp., Leguminosae, <i>O.</i> <i>europaea</i> , <i>Quercus</i> sp., <i>Pinus pinea</i> , <i>Vicia</i> sp., <i>Hordeum</i> sp., <i>Cicer arietinum</i>
Fo. XI	625 - 600 B.C.	13.5	-----
Fo. XII	625 - 600 B.C.	45.0	<i>V. vinifera</i> , <i>Triticum</i> sp., <i>Corylus avellana</i> , Leguminosae
Fo. XIII	650 - 600 B.C.	27.0	<i>Triticum</i> sp.
Fo. XIV	?	13.5	-----
Fo. XV	650 - 600 B.C.	85.5	<i>V. vinifera</i> , <i>Triticum</i> sp., Leguminosae, <i>C.</i> <i>arietinum</i> , <i>P. pinea</i> , <i>Quercus</i> sp.
Fo. XVI	?	40.5	<i>Triticum</i> sp., Leguminosae, <i>Hordeum/Secale</i> , <i>Brassica</i> sp., <i>P. pinea</i> , <i>V. vinifera</i>
Fo. XVII	675 - 625 B.C.	49.5	<i>Triticum</i> sp., Leguminosae
Fo. XVIII	700 - 650 B.C.	27.0	<i>Triticum</i> sp. (barley?)
Fo. XIX	700 - 650 B.C.	22.5	<i>V. vinifera</i> , <i>Triticum</i> sp., Leguminosae

CHART 1. Chronostratigraphical sequence of Fo.30.

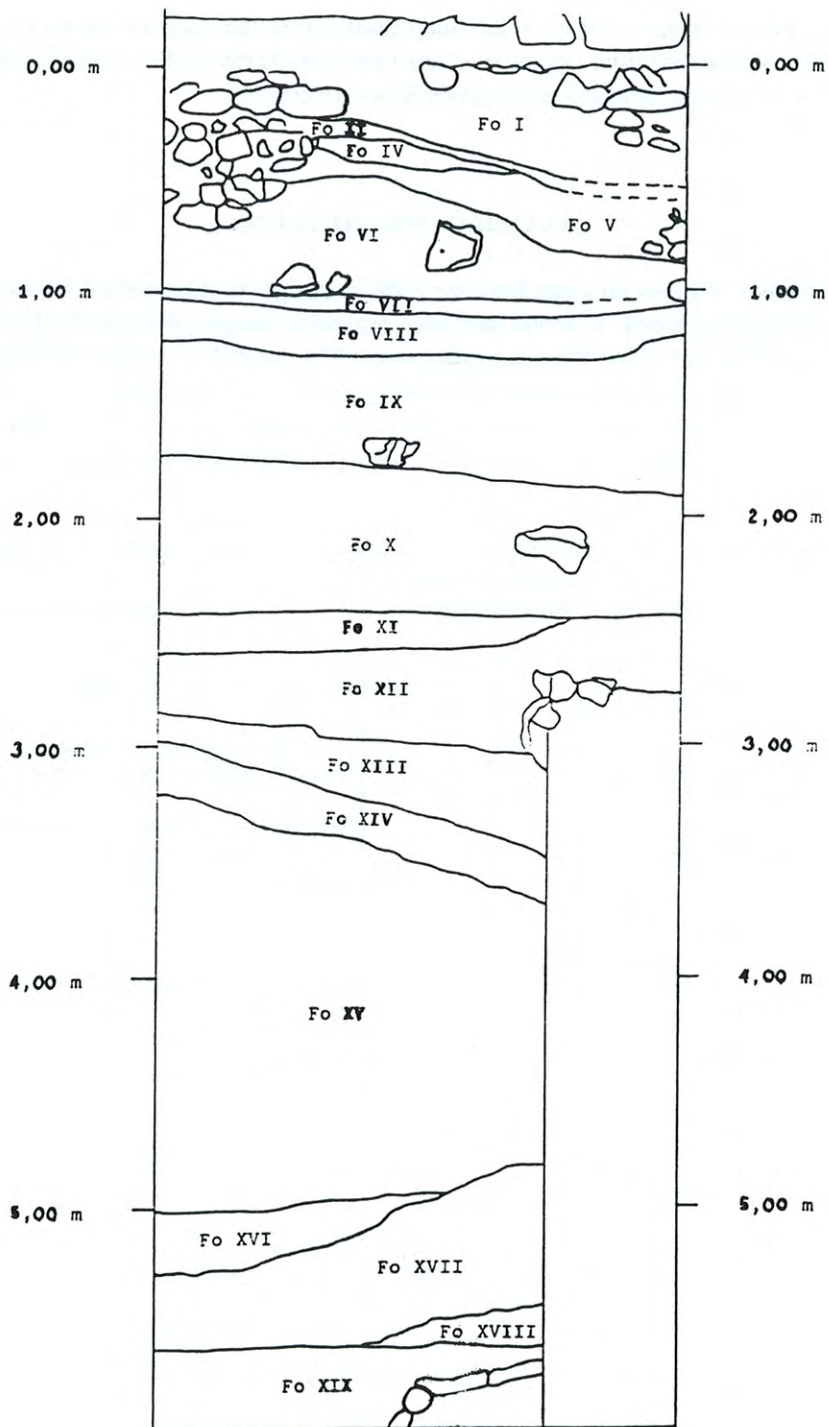


FIGURE 2. Stratification of the 1986 campaign at CDB (Fo.30).

549 tonnes of sediments have been water-sieved and floated. The sterile levels allow us to subdivide the sequence into three stages. Thus, we will refer to strata V-X as the recent, XI-XIV as the intermediate and XV-XIX as the old levels of the occupation at Fo.30.

Our methodology consists in following the abundance of each fish taxa through the 12 archaeologically meaningful strata to see whether any consistent pattern emerges. Number of remains (NR), without further specifications, have been used throughout the work: we think that in our case they are the simplest and most straightforward method of quantifying diversity.

Some use has been made of multivariate statistics, in particular factorial correspondence analysis, but only to further test the validity of some of the hypothesis emerging from our analysis.

RESULTS

The number of remains total 2445 specimens. Of these, 919 have been identified taxonomically (Table 1), a further 866 have been identified anatomically and 640 are unidentified fragments. Table 1 gives a complete list of all the taxa identified and their corresponding NR/level. When the raw data are further analyzed we have been able to detect four distribution patterns which we have named as follows:

TAXA/LEVEL	VI	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XIX	TOTAL
<i>I. oxyrinchus</i>	-	-	0	0	0	1	0	0	0	0	0	0	1
<i>Scyliorhinus</i> sp.	-	-	1	0	0	0	1	0	0	1	0	0	3
<i>G. galeus</i>	-	1	0	2	0	0	0	0	0	0	0	0	3
<i>M. aff. mustelus</i>	1	2	15	6	0	0	1	0	7	15	8	1	56
<i>Raja</i> sp.	-	-	2	2	0	1	0	0	0	5	3	0	13
<i>R. clavata</i>	-	-	0	0	0	0	0	0	1	0	0	0	1
<i>R. aff. radiata</i>	-	-	0	0	0	1	0	0	0	0	0	0	1
<i>D. pastinaca</i>	-	-	1	0	0	0	0	0	0	0	0	0	1
<i>M. aquila</i>	-	-	8	10	0	4	1	0	0	1	0	0	24
<i>A. sturio</i>	-	-	22	15	0	0	0	1	3	3	3	0	47
<i>M. helena</i>	-	-	6	7	0	1	0	0	0	0	0	0	14
<i>C. conger</i>	-	-	0	3	0	0	0	0	0	0	0	0	3
<i>B. sclateri</i>	-	1	14	11	0	2	2	0	1	2	0	0	33
<i>H. didactylus</i>	-	1	1	0	0	0	0	0	0	0	3	0	5
SERRANIDAE	-	-	0	0	0	0	0	0	2	0	0	0	2
<i>E. aff. guzza</i>	-	-	0	3	0	1	0	0	0	0	0	0	4
<i>D. labrax</i>	-	-	2	0	0	0	0	0	0	0	0	0	2
<i>D. punctatus</i>	-	-	0	0	0	0	0	0	2	1	0	0	4
<i>T. trachurus</i>	-	-	2	1	0	0	0	0	0	5	6	0	14
<i>P. mediterraneus</i>	-	-	10	32	1	43	1	0	14	7	4	0	112
<i>A. regius</i>	1	1	13	7	0	2	1	0	7	14	12	0	58
<i>M. aff. barbatus</i>	-	-	0	1	0	0	0	0	0	0	0	0	1
SPARIDAE	1	-	17	25	0	11	2	0	20	26	37	1	140
<i>D. dentex</i>	-	-	0	5	0	1	0	0	0	0	0	0	6
<i>D. gibbosus</i>	-	-	11	3	0	3	0	0	6	7	5	1	36
<i>Diplodus</i> sp.	-	1	6	0	0	0	1	0	2	2	0	0	12
<i>D. annularis</i>	-	-	0	0	0	0	0	0	0	0	1	0	1
<i>D. sargus</i>	-	-	0	0	0	0	0	0	0	2	0	0	2
<i>D. vulgaris</i>	-	-	3	9	0	0	0	0	3	1	7	0	23
<i>L. mormyrus</i>	-	-	0	1	0	0	0	0	0	2	3	0	6
<i>O. melanura</i>	-	-	0	0	0	0	0	0	0	0	2	0	2
<i>P. acarne</i>	-	-	0	1	0	6	0	0	0	4	0	0	11
<i>P. erythrinus</i>	-	-	0	2	0	0	0	0	7	10	14	0	33
<i>P. auriga</i>	-	1	3	1	2	0	1	0	0	0	0	0	8
<i>P. caeruleostictus</i>	-	-	2	0	0	2	0	0	1	0	0	0	5
<i>P. pagrus</i>	-	-	33	38	0	7	4	0	22	22	20	0	146
<i>S. aurata</i>	-	-	0	0	0	0	0	0	1	3	0	0	4
<i>Scomber</i> sp.	-	-	0	0	0	0	0	0	3	2	1	0	6
<i>S. japonicus</i>	-	-	0	0	0	0	0	0	0	0	1	0	1
<i>T. thynnus</i>	-	-	7	2	0	16	0	0	1	0	0	0	26
MUGILIDAE	-	-	2	9	0	1	1	0	0	4	1	1	19
<i>Ch. labronus</i>	-	-	0	1	0	0	0	0	1	0	0	0	2
<i>L. aurata</i>	-	-	0	1	0	2	1	0	1	0	0	1	6
<i>L. ramada</i>	-	1	8	3	0	0	1	0	3	1	0	1	18
<i>M. cephalus</i>	-	-	0	3	0	0	0	0	0	0	0	0	3
BOTHIDAE	-	-	1	0	0	0	0	0	0	0	0	0	1
TOTAL	3	9	190	204	3	105	18	1	108	140	131	7	919

TABLE 1. Castillo de Doña Blanca: number of remains of the different fish taxa in the stratigraphic levels found in the sample square analyzed in the paper (Fo.30).

1) INCREMENT MODEL (Figure 3):

It refers to taxa with low NR in the oldest levels, which steadily increase towards the later stages of occupation. This tendency can be represented either as histograms or cumulative frequency curves. The most representative species in this group are *Barbus sclateri* and the sturgeon (*Acipenser sturio*) but the pattern is also evidenced, in a somewhat more restrictive way, by the grey mullets (Mugilidae), the thinlip mullet (*Liza ramada*) and the eagle ray (*Myliobatis aquila*) among others (Table 1). Species such as the redbanded seabream (*Pagrus auriga*) seem to follow this pattern also, though in a slightly different way for they exclusively appear on the recent levels.

2) EXTINCTION MODEL (Figure 4):

Constitutes an inverse situation of the former pattern. It refers to taxa which are concentrated in the oldest levels but become increasingly uncommon with time and might disappear altogether from the most recent strata. The typical case is that of pandora shown in Figure 4, but the pattern is also evident in the horse mackerels (*Trachurus* aff. *trachurus*), the gilthead (*Sparus aurata*), saddled seabream (*Oblada melanura*), and the mackerels proper (*Scomber japonicus* and *Scomber* sp.). Once again, sparids seem to exhibit a more drastic version of the model, being exclusively restricted to the old layers.

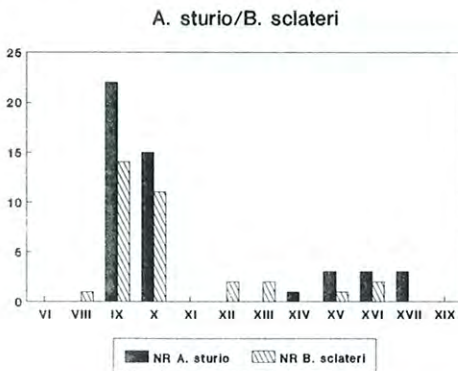


FIGURE 3. Stratigraphic distribution of taxa which fit the INCREMENT MODEL.

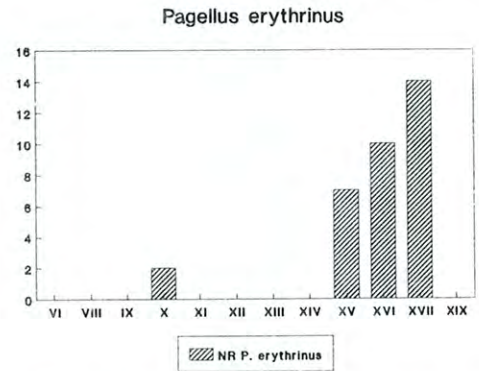


FIGURE 4. Stratigraphic distribution of taxa which fit the EXTINCTION MODEL.

3) CATASTROPHIC MODEL (Figure 5):

A typical case of bimodal distribution, this pattern is of utmost importance since, except for the rubberlip grunt (*Plectorhynchus mediterraneus*), it is exhibited by every single one of the important taxa (in terms of NR) at CDB. All these species appear from the oldest strata, to the youngest ones. There is, however, a time lapse in which they either become very rare or disappear altogether from the record (one or the other option seems to depend, to a large extent, on their overall NR values). This period of low abundance corresponds to the "intermediate" stage of the occupation (i.e., from Fo. XIV-XI, but mainly Fo. XII which is one of the rich strata). This pattern accounts for the behaviour of 46% of the total NR at CDB, so it does not seem to be a mere coincidence but probably reflects the action of some important agent(s) at the site. Species of secondary or marginal importance never conform to this particular distribution model.

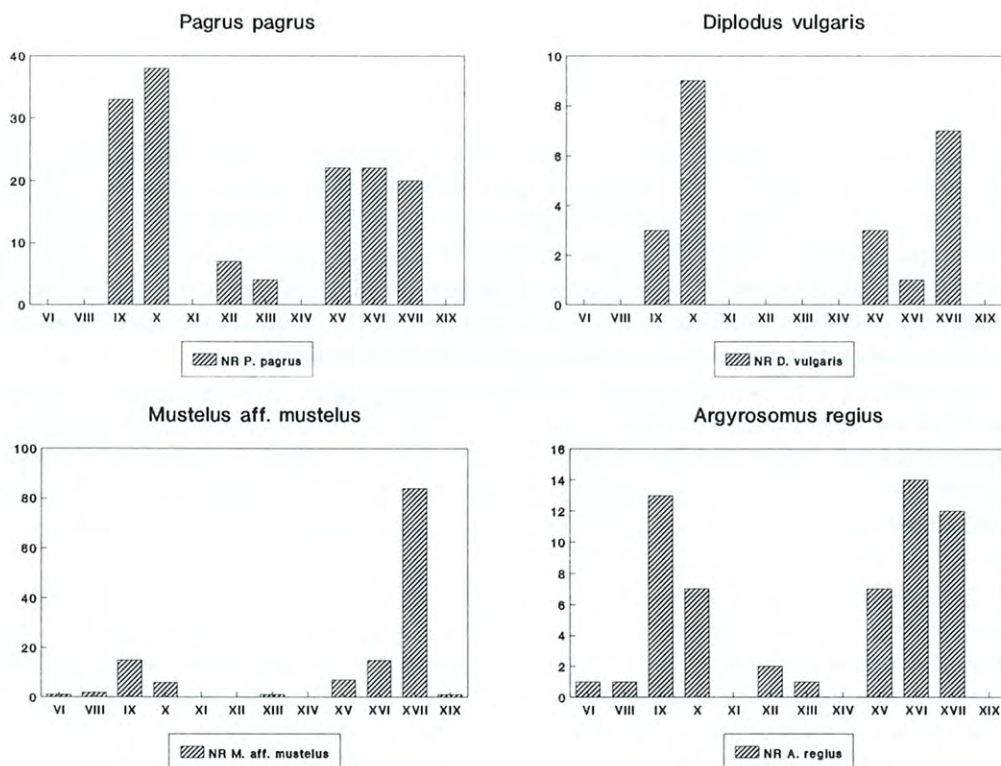


FIGURE 5. Stratigraphic distribution of taxa which fit the CATASTROPHIC MODEL.

4) EXPLOSIVE MODEL (Figure 6):

A unimodal pattern which is the most restrictive model at CDB in terms of NR and taxa. It is exhibited only by two species (rubberlip grunt, *Plectorhynchus mediterraneus*, and bluefin tuna, *Thunnus thynnus*). The explosive model is characterized by a radical increase of these animals during the intermediate levels of the occupation, most notably at Fo. XII. Because of it, the pattern is an inverse version of the catastrophic model. Though very few taxa follow it, the occasional appearance at this stage of species such as the mako shark (*Isurus oxyrinchus*) is particularly significant as we will see below.

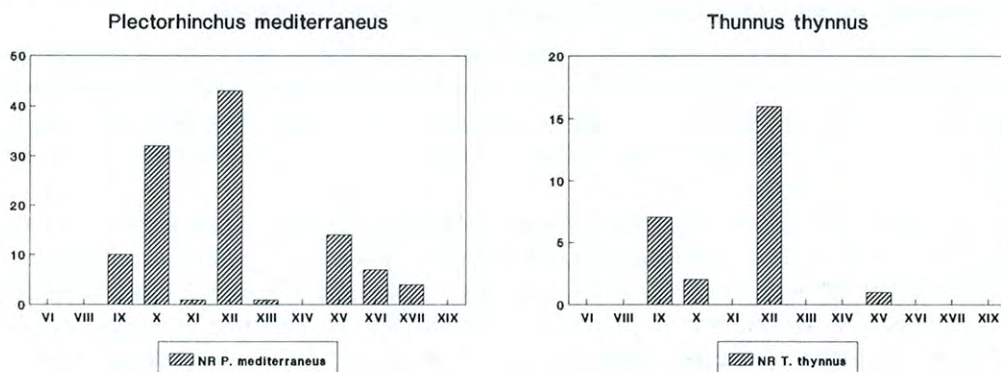


FIGURE 6. Stratigraphic distribution of taxa which fit the EXPLOSIVE MODEL.

DISCUSSION

Four distribution patterns, therefore, appear when analyzing the ichthic assemblage. Could this be a mere coincidence or an artifact brought about by some biasing agent? certainly not taphonomic loss, for the retrieval methods employed render such a possibility highly unlikely. The overall sample size also seems to be a guarantee against biases as also is the excellent preservation state of the remains. A couple of linear regression analysis of NR on the depth of each level provide extremely low correlation coefficients ($r = 0.4562$ and $r = 0.4915$) indicating that faunal abundance seems to have been independent of volume of sediment retrieved in the strata.

To further test the possible existence of some grouping agents in the taxocenosis, a total of fourteen factorial correspondence analyses have been run on the samples. Cases and variables were different in each run (species, genera, families, strata or groups of strata of equivalent chronology) but results have always been essentially the same. Figure 7 shows the results of one such correspondence analysis. In this instance species act as variables and single strata as cases for the building of the axes.

From the graph a segregation of strata and species along the first axis seems evident. Thus, on the upper side, we have what we have called the "recent levels of occupation" (Fo. IX and X) which are confronted to the old levels (Fo. XV, XVI and XVII) on the lower side of the graph (dotted lines and arrows). The youngest strata appear closely associated (and their position defined by) a series of species of which the most important ones are the sturgeon (*Acipenser sturio*) and *Barbus sclateri* (on a multiple point) but also, in a decreasing order of importance, eagle ray, thinlip mullet and the stingray (*Dasyatis pastinaca*).

Similarly, the oldest strata appear to be closely associated with all numerically important species and, in particular, those that characterize the extinction model, namely, pandora, gilthead, saddled seabream and chub mackerel (also on a multiple point) plus horse mackerel.

The intermediate levels and their associated species (bluefin tuna, rubberlip grunt and mako) are plotted with the recent strata but do not seem to confront the old strata in the way that the young levels do. From this perspective we can say that they also occupy an "intermediate" position in the graph.

Analysis of the biology of the species involved helps in explaining, at least partially, two of the patterns. Both the increment and the extinction models exhibit a gradual change in the abundance of populations so we are led into looking for natural agents as their causal factors.

In this case, the gradual filling up of the waters around CDB, due to the accumulation of alluvial sediments from the river Guadalete, seems to be the most obvious choice. The process is still under way and, as usually happens in restricted areas, at an increasingly faster rate than in the past. A process of this same kind has built the "marismas" (swampland) from the Guadalquivir river some 30 Km to the north of the Bay of Cádiz.

What these two models reflect then, would be the response which different fishes give to an originally marine, deep water, environment which progressively becomes brackish more shallow and with a less stable substrate (sand vs. rock). For some species this change is beneficial and their numbers increase. No wonder that the increment model includes the only true freshwater species at CDB (barb) plus representative amphidromous species (sturgeons, grey mullets) or members from others which tolerate low salinity (eagle and sting rays).

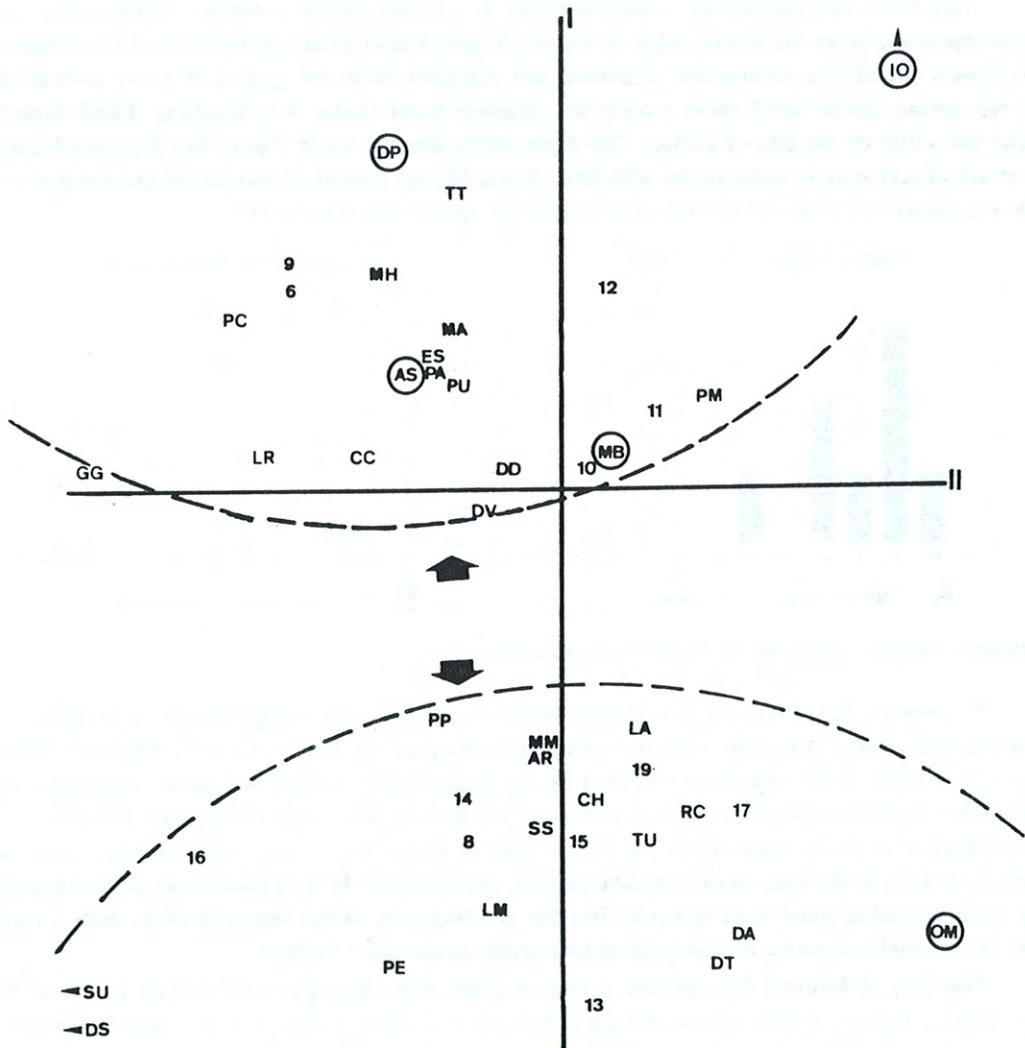


FIGURE 7. Graphical representation of the plot from the two first axis a correspondence analysis carried out with taxa (species) and stratigraphical units (Fo.) from the sample square studied in the paper.

We can assume that when these environmental changes were negative, the species reacted by either decreasing their presence or disappearing altogether. It is, then, no coincidence that the most pelagic of fishes (except for the mako and bluefin tuna) are only present or abundant in the old stages of the occupation.

That these two patterns are complementary to a certain extent is further evidenced by cases when changes involve the replacement of species. Figure 8 depicts the stratigraphical distribution of two closely allied taxa (redbanded seabream and gilthead). Both are typical of rocky bottoms but *Pagrus auriga* comes much more readily into shallow water (today it is regularly fished from the docks and cliffs on the city of Cádiz). The replacement that we see in Figure 8A, is probably, then, the result of a change in water depth with time. When NR are plotted as cumulative percentages over time the tendencies followed by both species become spectacular (Figure 8B).

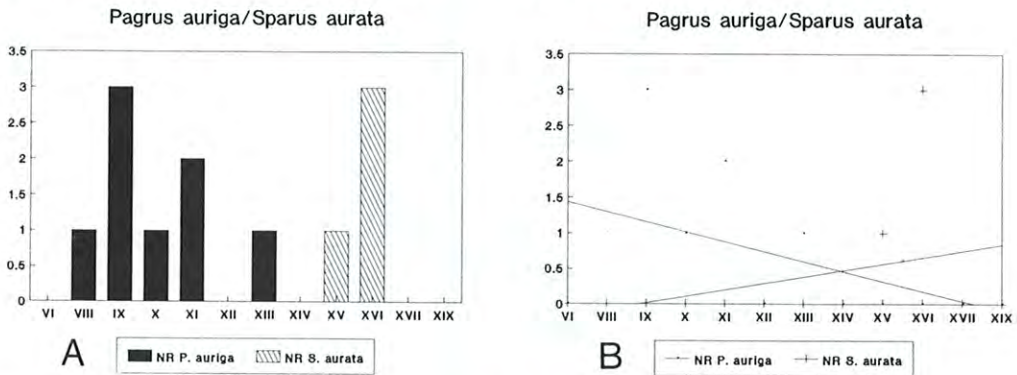


FIGURE 8. Temporal replacement of gilthead by redbanded seabream.

In contrast, the remaining two models seem to record a more abrupt change. It is difficult to correlate abundances over time with any single natural agent. Moreover, the time lapse involved is short (25-50 years at most) perhaps too short for any natural agent to have any chance of significantly influencing the taxocoenosis of the Bay, unless we are dealing with a true catastrophe, but there is no archaeological evidence whatsoever for such a type of event (Ruíz Mata, verb. comm.). Also, the changes, at least in the case of the bimodal pattern, are recurrent. If both models are plotted together they even resemble some kind of cycle. But the synchronicity of the fluctuations in such a varied array of taxa make us prone to disregard natural agents as causative factors.

One way of tackling this impasse is to look again at the biology of the species involved. The most striking feature of both groups of taxa is that whereas those included in the catastrophic model are all potentially found on the Bay of Cádiz, even today, the explosive model has species of a much more pelagic type of environment and, at present, none of them are to be found in the area. We seem, thus, to be confronting a potentially autochthonous fauna with an alloctonous one.

A peculiar finding along these lines was to see that species of the explosive model are characteristic of tartessian sites whereas those from the catastrophic model can be found on any site along the andalusian coast today (Roselló & Morales, 1988). As a matter of fact, tartessian sites are set apart from all others by the abundance of pelagic species (tuna fish and big sharks, in particular) indicating that a different fishing strategy seems to have been at work in those places (Roselló & Morales, 1992).

A final peculiar find within this argumentative context has to do with the types of remains found from tuna fish, for all of them are restricted to bones of the dorsal and anal fins (basal pterigophores, acanthotrichia and lepidotrichia). This is a most striking result for it is precisely the missing bone categories in tuna fishes what make up the samples from the remaining teleosts; this skeletal spectrum, therefore, not only evidences carcass processing but also of some kind of selective transport of animals to the site.

All the data taken together seem to point to some kind of cultural agent as the responsible cause of both the catastrophic and explosive models. What kind of cultural agent? at this stage, the archaeological data come to the rescue of the zooarchaeologist. For, as we have stated before, the change which both distribution patterns spot, coincides with a moment of intense commerce and interchange with local populations. This commerce, both along the coastline and the rivers of southern Andalusia, no doubt required people acquainted with sailing so that it probably detracted labour force from the fishing industry which, in turn, declined. If such shift is confirmed the catastrophic model might only be a reflection of changes introduced in the site's economy which caused a momentary decline in fishing. It is important to stress at this moment that shell cropping did not experience any changes of this kind though the environmental changes did produce gradual shifts in the abundance of species (Moreno, in press). The confirmation of the commercial change, on the other hand, would automatically explain the import of tartessian goods into CDB of which tunas and sharks, either marinated, dried, or prepared in any way which implied the selective removal of parts of their skeleton), were regular elements as seems to be documentarily stated (Ruíz Mata, verb. com.).

There are, obviously, alternative explanations but none seem so parsimonious. One of them states that the phoenicians started to fish in the tartessian way (eventually they did so, for the cartaginians, their descendants, exported tuna fishing technology to other parts of their empire). This hypothesis is testable: if they did so, why, then, did tuna fish or pelagic sharks drop or disappear in the latest stages? why resume with the fishing in the filled-up Bay when fishing in open waters was so much more productive?. Also, this hypothesis fails to account for a further point: why don't we find any remains of tuna other than fin-rays? many other places at CDB have been now excavated and we have sorted thousands of fish bones from them. Except for one single vertebrae from cartaginian levels (3rd century B.C.) nothing but fin rays from tunas have been retrieved (Roselló, in prep.). Perhaps the places where the processing factories were located have not been detected yet, but this also seems unlikely for the whole seaside perimeter of the city (including the harbour) is now more or less known and tuna fish are easy to spot due to the size of their bones (Morales, 1993).

An alternative hypothesis would hold that it was the tartessians in neighbouring villages, or at CDB itself, the ones that did the pelagic fishing while phoenicians concentrated on species in the Bay. If so, why do pelagic fishes appear so late in time, and precisely in a moment when common species decrease?. Did tartessians took over fishing when phoenicians depleted the local populations? why, then, do local populations of fishes reappear so soon?. In all cases, these hypothesis also fail to explain the aberrant sample of the tuna fish bones.

CONCLUSIONS

Though research on these collections is still under way some conclusions might be drawn from our survey (Figure 9):

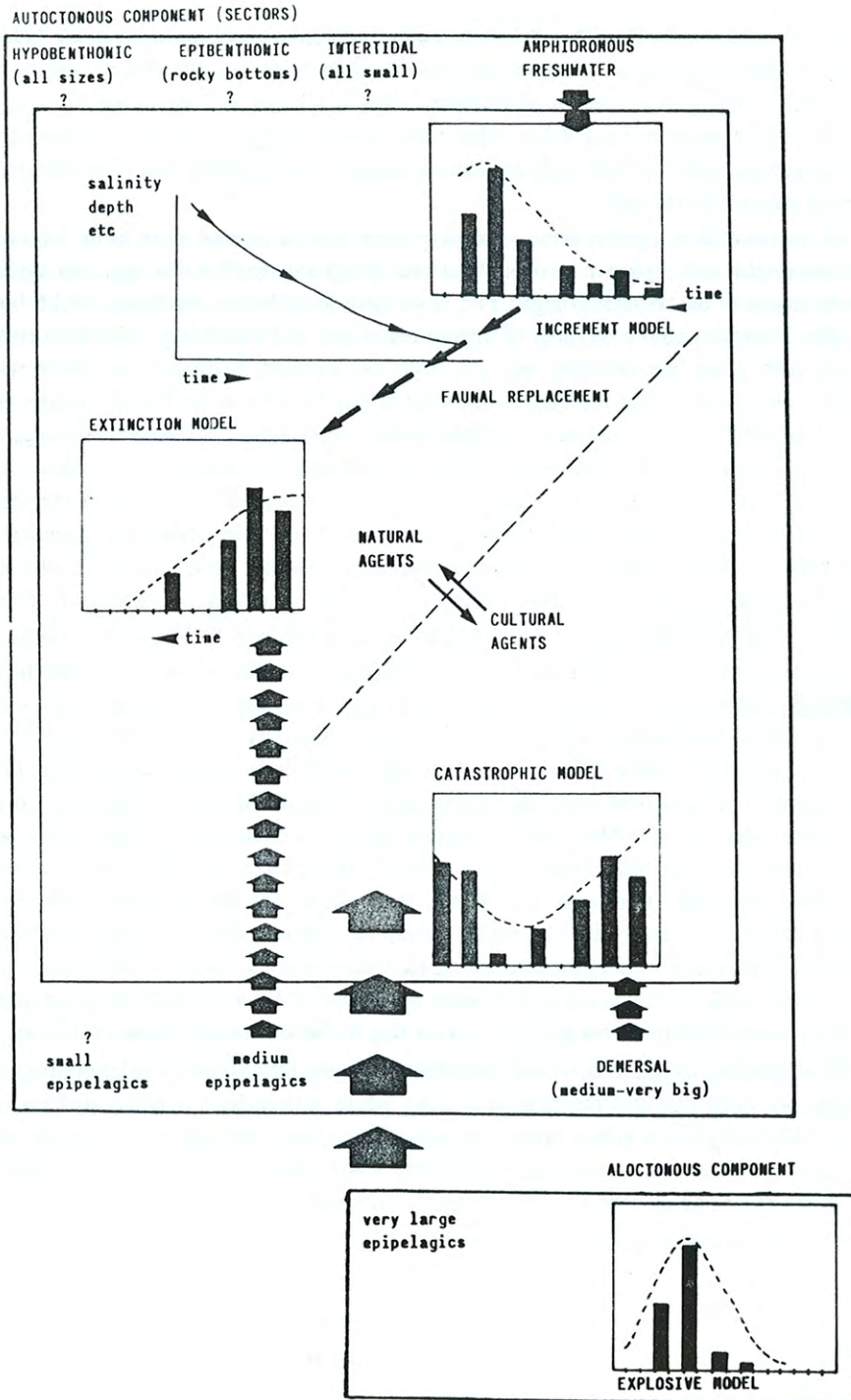


FIGURE 9. Castillo de Doña Blanca: overall explanatory chart of the ichthic associations from the sample square analyzed in the paper.

1) The taxa described have distributions which fit neatly into one of four models of abundance (increase, extinction, catastrophic and explosive).

2) Of these, two (increase + extinction) seem to be gradual and probably caused by some natural agent (i.e., increasing influence of the Guadalete river through time).

3) The remaining models (catastrophic plus explosive) are more abrupt and caused probably by cultural agents. Commerce, both detracting labour force from fishing and importing foreign fishes, looks like the agent which best conforms to our data.

4) Analysis of the sizes of these animals and analysis of taxa found in the Bay of Cádiz at present detects a selective type of fishing, probably with hooked gear, concentrating on medium to very big sized demersal specimens which further helps in reinforcing the hypothesis of a cultural agent as the causal factor for the catastrophic and explosive models.

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