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Assesment of season, fish size and place of release of reared Gilthead sea bream, destined to stocking at sea.

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ABSTRACT

Gilthead sea bream, *Sparus aurata*, is a marine fish of the family of the Sparids. It is a highly level proteic and commercial species in the Mediterranean countries, wich can easily be produced in hatcheries from 1983. It was aimed to increase Gilthead sea bream fishery in the Cadiz Gulf. The season, fish size and place of release were monitored. Between 1993 and 1997, 35330 gilthead of four different weights were released. Fish averaged: 15, 100, 316 and 854 g. Of these, 28746 were marked. The fish were released in four zones of the shore of Cadiz, and two zones in Huelva shore. For each zone, the displacements, growth, the oldest recapture and the percentage of recapture were determined. Between these zones, the two of the Huelva shore were discarded, showed the greater movements (42.6±30.5 km., $p<0.05$) and the smaller growth of all the zones (Specific Growth Rate(S.G.R.)= -0.20±1.01, $p<0.05$). The four zones studied in Cádiz, were found suitable for stocking. The Bay of Cadiz, turned out to be the most suitable, by having the greater recapture rate (1.4%), highest growths (S.G.R.=0.86±0.98), and smaller displacements (8.2±14.1 km.). In this Bay the older recapture was obtained (583 days). With the exception of fish released at Palmones River, fish of all the others releasing zones displaced to the Bay. With respect to fish size, better results were obtained with fish of 100 g. The fish of 15 g. showed descendent recapture rates (0.01%). Fish greater than 316 g. made diplacements significantly greater than the other fish (43.0±31.2 vs 9.6±15.8 km, $p<0.001$). The fish released in spring and summer (between March and July), had a greater growth than fish released in autumn and winter (between October and December, S.G.R.=0.68±1.08 vs 0.23±1.11, $p<0.05$).

Keywords: Gilthead sea bream , Gulf of Cadiz., Place of release, Season of release, Size of release, *Sparus aurata*, Stocking, Tagging.

INTRODUCTION

In most of the industrialized countries of the world the deplection of artisanal and littoral fisheries is common. Two are the main factors affecting the problem, the overfishing of the coastal and littoral fishing grounds and the degradation of the hatchery and nursery grounds for commercial species. One of the results of the overpopulation of coastal zones is the contamination and the coastal development. In the last years the increasing demand of this kind of fishing it is very clear, causing the improvement of the fishing gears. Moreover, the overfishing cause not only decreasing over fish populations, but also loss genetics that increment the negative effect of the overfishing.

The solutions to these problems are complex and mainly consist in reducing fishing and the decontamination of coastal zones. Moreover, in some countries as Japan, U.S.A., or Norway, after some years of research, have been developed efective techniques to restock the marine littoral with marine fish (Matsuda, 1991; Svasand, 1991; De Vries & Stein, 1990; Anonimo, 1988; Bartley, 1995).

The artesanal and sport fisheries have gotten high level of production. The benthic resources have been recuperated, too (Anonimo, 1988). So, the aquaculture have demostrated to improve the fishery. In Japan more than 80 species were restocked in 1990. More than 10 millions of juveniles from the 10 more

importand species have been released, as well as 280 millions of postlarvas of prawn and 3.231 millions of pectinics between 22 zones of restocking and ranching (Matsuda,1991).

In our coasts these techniques are unusual, only one experience have been performed in Spain with turbot, *Scophtalmus maximus* L. (Iglesias & Rodriguez-Ojea, 1994).

We have selected the Gilthead Sea Bream, *Sparus aurata* L. because it is a usual species in the european aquaculture and it can be produced with facility in the hatcheries.Few works have been done on historic captures of Gilthead sea bream in Cádiz Bay (Muñoz y Sanchez-Lamadrid, 1994), but local fishermen asserts that their numbers have decreased very much due to overfishing.

Githead Sea Bream is a high level proteic and commercial species and it is autochthonous of Andalusian and have an littoral distribution (Suau y Lopez, 1976).

The efficiency of restocking depend on several factors (Tsukamoto, 1993; Bartley, 1995) that we verify with the Gilthead Sea Bream: the releasing point, season, adequate size of released fish and the ability of the fish to grow in the wild.

This species is a good candidate to do marine renching in Mediterranean coastal zones, with overexploited stocks of fish.We hope that these kinds of techniques were used in the countries with problems in their littorals, sport and artisanal fisheries, signifying a reciprocal profit between fishing and aquaculture.

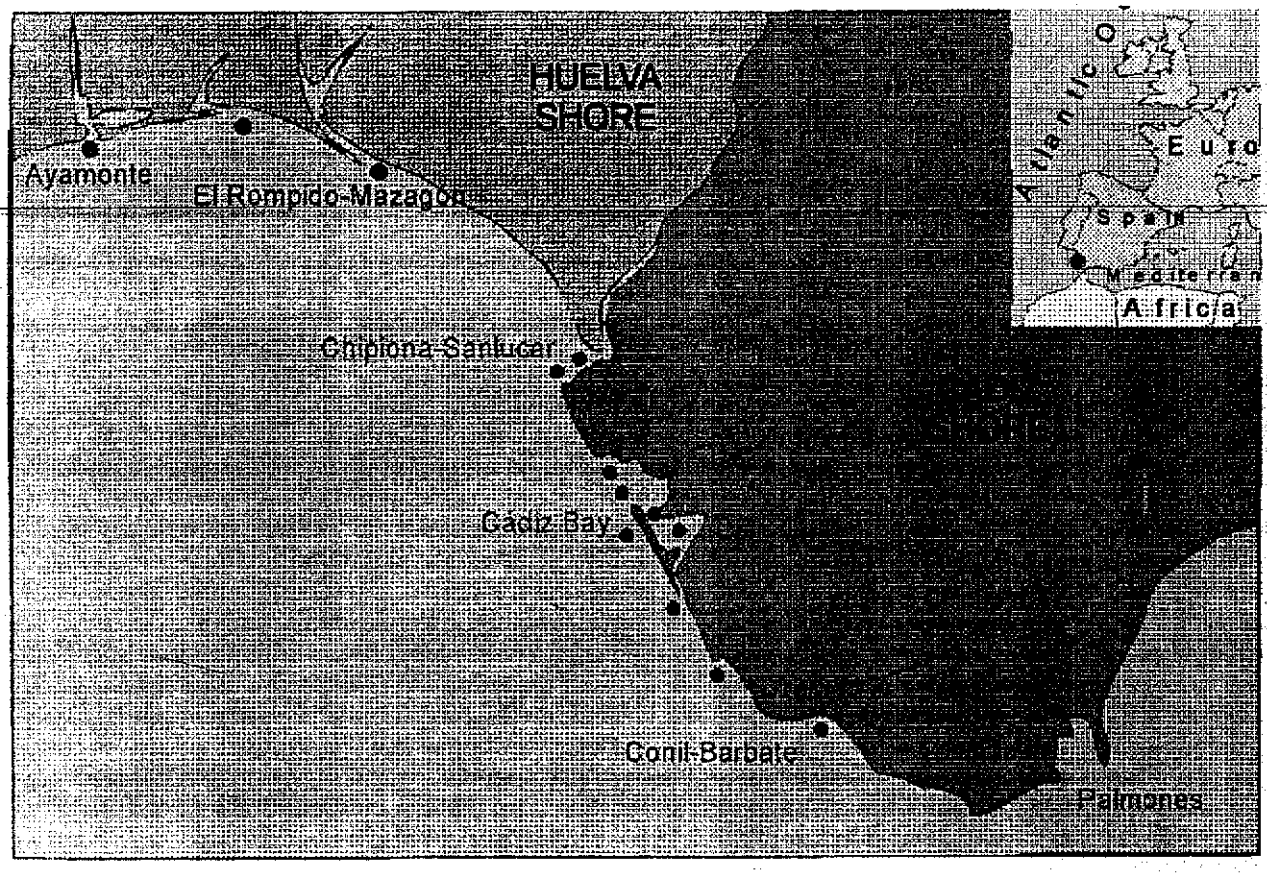
MATERIALS AND METHODS

Between 1993 and 1997, 35,330 gilthead sea bream of four different weights were released. The gilthead sea bream were produced in the facilities of C.I.C.E.M. "El Toruño" (Latitude N 36° 34', longitude W 6° 12'). Fish averaged: 15, 100, 316 and 854 g. Of these, 28,746 were marked, those of 15 g. through the mutilation of a pelvic fin, tattoo with ink or Fingerling tag FTF69 (Floy Tag) and the rest with Anchor tags (FD68, FD94, FD68BC and FF94, Floy Tag). Anchor tags (FD94 and FD68) and Fingerling Tags, were found suitable for marking fish of 100g and 15 g.. The anchor tags are a plastic filament, with an extreme in T, that is introduced in the dorsal musculature as an anchor.Tagging practises were described by Sanchez-Lamadrid (1997). The fish were released in four zones of the shore of Cádiz: Chipiona, Bay of Cádiz, Conil-Barbate and Palmones River, and two zones in Huelva shore: El Rompido-Mazagón and Ayamonte (Fig.1).The fish were overgrown before released to maintain reserves the first days after released.

The restocking were carried out using a truck to transport fish and then the fishes were released directly at sea or to a restocking cage. A towed floating cage with 8 m^3 of capacity was used to carry the fish as far as releasing points were separated from coasts. In the case of Huelva restocking and some of the Cadiz restocking, the fishes were carried in tanks placed on top of the boat to the releasing point and the saltwater of the tanks were renewed with sea saltwater by means of bulging. In every cases the sistems used were successful. In order to see the influence of the point of release, direct release in harbours or by boat (cage or tank on the top) were compared. In spring 1995, six releases were done, three of them in Chipiona, Barbate and Cadiz Bay (Sancti Petri Tidal Creek) and the others one in an open sea point 1 mille away from the shore release point.In each releasing point the Delegacion Provincial de Pesca in Cádiz contributed, faciliting the authorizations, the necessary boats, personal, and vehicles. Moreover, they it called the communications media that divulged the necessary information to obtain the fishermen recaptures. The Cofradias of fishermen, the Organizations of producers and the Associations of sport fishermen have actively contributed. We put informative posters in Markets, Sport Ports and points of interest and also we distributed a lot of recaptures printed forms. The recapture paper gave us information about recapture point, number and kind of tag date, weight and size, fishing gear used, and number of no tagged gilthead seabream

captured. Other data as stomach, scales, weight of liver, were recorded when fishermen give recaptures. Then, we could deduce movements, apparent speed and growth. Growth was calcultated as Specific Growth Rate (SGR=lnWt-lnWi/days.%), and the monthly growth increase is given in grams. Condition index were calculated as WL^{-3} The releases in Huelva Shore were done in colaboration with CICEM "Aguas del Pino". A 3 days trawl survey was done in tne Inner Cadiz Bay to obtain recaptures. The differences were analyzed with a test t-student or non parametrics comparison when no normal data were used.

Figure 1. The six zones of releases in the Gulf of Cadiz.



RESULTS AND DISCUSSION.

A total number of 348 recaptures were obtained until march 1998. The assesment on the place of releasing depends on several factors displayed in Table I. The Huelva shore released fish showed significatively greater displacements than the Cadiz shore fish (Table I, $p \leq 0.05$), and therefore smaller growth. The rate of recapture is greater in Huelva shore releases than in Cadiz shore, but when only fish greater than 15 g. were considered, recapture rate of Cadiz shore is double than Huelva shore. Usero *et al*, (1997) described the heavy metal pollution in the waters of the Huelva littoral, which could be the reason for the worse results. The four zones studied in Cadiz, were found suitable for stocking. The Bay of Cadiz, turned out to be the most suitable, by having the greater recapture rate (1.4%) and the older recapture (583 days). Although Palmones showed greater growth and smaller displacements than Cadiz Bay showed, the extreme environmental changes of the Palmones estuary, confirmed the Cadiz Bay as the better place for stocking in the Gulf of Cadiz. With the exception of fish released at Palmones River, fish of all the other releasing zones, Huelva shore included, displaced to the Bay.

Zone	Displacements (Km)	Growth (SGR)	% Recaptures	Maximal Number of days from release
Cadiz shore	**8.3±13.5**	**0.82±1.02**	**0.86**	**583**
Chipiona-Sanlucar	11.5±7.8	-0.40±0.27	0.83	418
Cadiz Bay	8.2±14.1	0.86±0.98	1.40	583
Conil-Barbate	9.1±12.6	0.53±1.09	1.24	378
Palmones	1.5±1.1	1.55±1.50	0.53	145
Huelva shore	**42.6±30.5**	**-0.20±1.01**	**1.83**	**164**
Rompido- Mazagon	36.9±28.1	-0.36±1.01	1.60	86
Ayamonte	39.6±34.8	0.02±1.01	2.60	164

Table I. Average Displacements and Growth, Recapture rate and Number of days from release of the oldest recapture in the six studied zones

With respect to the fish size (Table II), better results were obtained with fish of 100 g. The fish of 15 g. showed descendent recapture rates (0.02%). A size dependent mortality ocurred, as described Leber (1995). The good displacement and growth data for 15 g. fish, moved us to solve the behavioral problems involved in reared fingerlings releasing of fish (Olla *et al*, 1994).

Fish greater than 300 g. made displacements significantly greater than the other fish (9.6 and 43.0 km, $p \leq 0.01$) and had negative growth.

Average weight	Displacement (Km)	Growth (SGR)	% Recaptures
15g	9.6±15.8	2.32±0.72	0.02
100g	9.6±15.8	0.73±0.98	3.60
316g	43.0±31.2	-0.30±1.12	1.83
854g	43.0±31.2	-0.05±0.87	1.83

Table II. Average Displacements and growth, and recapture rate for the four classes of weight of fish .

The fish released in spring and summer (between march and july), had a greater growth than fish released in autum and winter (between october and december, S.G.R.=0.23 and 0.67, $p<0.05$). Percentage of recaptures and displacemnets were favourable in spring and summer releases, as Table III shows.

Season	Displacement (Km)	Growth (SGR)	% Recaptures
Spring / summer	13.5±20.4	0.68±1.08	1.1
Fall / winter	19.6±30.2	0.23±1.11	0.2

Table III. Average displacements and growth, and recapture rate for the two seasons considered.

Condition index of released and recaptured fish did not show differences, showing good adaptation of released fish to the sea (2.02±0.28 *vs* 2.13±0.6, p>0.05).

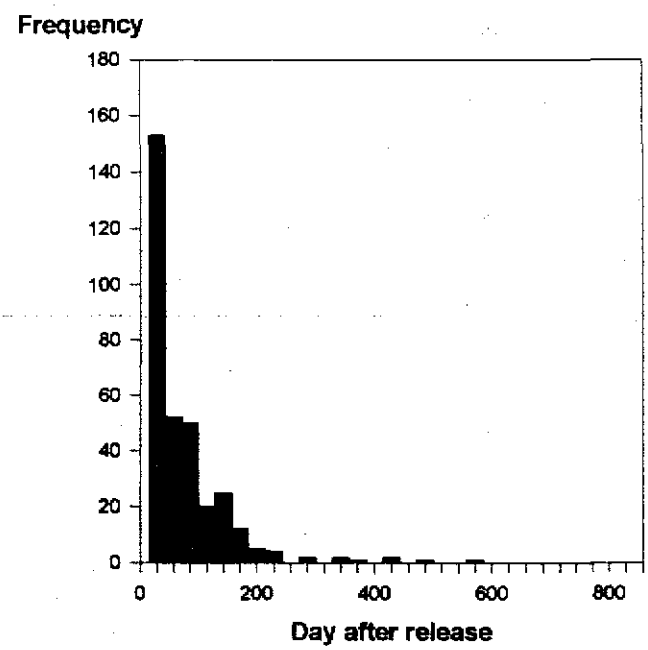
The effect of opensea *vs* harbour releasing of fish is shown in Table IV. No differences were found between the two releasing techniques, except for recapture rate in Cadiz Bay and for displacements in Chipiona releases. The wide difference for recapture rate in Cadiz bay is explained by natural atraction of gilthead seabream to tidal creeks (Arias, 1990). The small number of recaptures for Chipiona harbour release, make no significative the difference.

Zone of release		**Displacement (Km)**	**Growth (SGR)**	**% Recapture**
Chipiona	**Open sea**	12.9±8.1	-0.5±0.2	1.6
	Harbour	5±2.8	0.13	1.6
Cadiz Bay	**Open sea**	6.6±3.2	1.31±1.2	1.0
	Tidal creek	6.7±5.1	0.93±1.1	8.7
Barbate	**Open sea**	11.2±14.8	1.61	1.6
	Harbour	13±22	0.57	2.7

Table IV. Effect of open sea/ harbour releasing of fish in average displacemnt and growth, and recapture rate.

The importance of restricting the fishing in the stocking zones is shown in Fig. 2. The fish needed 15 to 30 days to adapt to the new environment, coinciding with the main fishing activity on it. 75% of recaptures occurred the first 90 days.

Figure 2. Time frequency of the recaptured fish



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