Development of Diets for Gilthead Bream *Sparus aurata* L. cultured in Egypt

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ABSTRACT

Two novel raw materials, dry germinated soyabean meal and fish silage, were used as the major protein sources in Sparus aurata feeds. Amino acid analyses of both materials, on one hand and the experimental fish on the other hand, proved that they meet or exceed the requirements of the species.

Three balanced diets were formulated on the basic idea of replacement of fish meal either partially, by defatted soyabean meal/dried germinated soyameal, or completely by a mixture of both soyabean meal and fish silage. Preliminary observations, under aquarium conditions, indicated that these artificial feeds are appropriate for the species.

Table 1. Composition (% Dry Weight) of raw materials.

Ingredients	Crude protein	Ether extract	Carbo-hydrates*	Metabolic energy	Calcium	Phosphorus
Fish silage	73.4	17.1	1.2	14.7**	1.0	1.5
Soyabean meal, defatted	44.0	1.0	39.3	9.4	0.3	0.6
Fish meal	65.0	4.0	5.0	11.8	6.0	3.0
Dried germinated soya	43.9	16.7	28.2	15.4**	0.2	0.6
Cod liver-oil	-	100	-	35.0	-	-
Soyabean oil	-	100	-	37.0	-	-
Wheat starch	-	-	100	13.0	-	-
Calcium carbonate	-	-	-	-	38.0	-

* Includes nitrogen free extract and crude fiber. ** Estimated.

Table 2. Amino acid profiles for soyabean meal, fish silage and sea bream muscles.

Amino acid	Dry germinated soyabeans (g/100g)	Fish silage	Sea bream muscles (g/100g protein)	requirements*
Arginine	5.59	4.97	4.14	1.7/34**
Histidine	4.30	3.24	1.97	-
Threonine	2.97	3.58	5.63	-
Isoleucine	3.64	3.65	2.18	-
Leucine	6.09	6.08	6.06	-
Valine	3.86	4.13	3.60	-
Lysine (LYS)	4.49	7.23	6.49	1.7/34
Methionine	1.25	2.48	1.88	1.4/34
Tryptophan	-	0.87	-	0.2/34
Phenyl alanine	4.30	3.24	1.75	-
Aspartic acid	15.20	8.19	8.85	-
Serine	4.15	3.60	6.63	-
Glutamic acid	13.03	12.09	11.54	-
Glycine	3.14	4.80	17.45	-
Alanine	3.54	5.13	14.57	-
Tyrosine	4.03	2.80	1.22	-
Proline	4.46	3.57	3.71	-
Cystine	1.13	0.67	-	-
Availability LYS	4.31	-	-	-
% availability	96%	100%	-	-
% recovery	83%	79%		-

* After Sabaut and Luquet, 1974 (Loc. cited Wilson, 1985).
** Percent of protein in the diet.

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Catch data from an artificial reef and a control site along the Central Adriatic Coast

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Artificial reefs are generally constructed in coastal waters around the world to enhance nearshore fisheries for their fish-attraction effect and increased production (BONSACK and SUTHERLAND, 1985). These effects should be particularly evident in areas far from natural reefs where the artificial substrates provide additional food, shelter from predation and greater habitat availability (BONSACK, 1989).

In order to evaluate the effectiveness of artificial reefs along the Adriatic coast and their influence on the fish assemblage and yield, 25 experimental fishing samplings were carried out from January 1988 to December 1989, both in a site sheltered with a concrete artificial reef and in an unprotected control site. Both the sites are situated along the central Adriatic coast, in front of Senigallia, on a sandy-muddy bottom (depth 10-11 m), at a distance of 2.5 miles from each other and 1.2 miles off-shore. The artificial complex, completed in October 1987, consists of 29 pyramids, each made of five concrete cubic blocks, and 12 concrete cages for shellfish culture (FABI and FIORENTINI, in press).

The fishing samplings were carried out monthly with a trammel net (length 500 m; height 2 m; inner mesh size 70 mm; outer mesh size 340 mm), lowered into the water at sunset and pulled in at dawn, for an average of about 12 hours at sea.

A total of 41 species were recorded over the two sampling years: 32 were fishes, 4 crustaceans and 5 molluscs. Of these 40 species (31 fishes, 4 crustaceans and 5 molluscs) were reported from the artificial reef and 32 (27, 2 and 3 respectively) from the control site, corresponding to 98% and 78% of the total species composition. The average values of catch were 10.4 kg at the reef site for a total yield of 260.5 kg, (59% of the total catch) and 7.3 kg at the control site for a total of 182 kg (41%).

In both sites the catches consisted mainly of fish, other than an exceptional catch of *Squilla mantis* recorded in April 1989 at the control site (Table 1). Molluscs were mainly represented by *Sepia officinalis* (86%), a sandy-muddy bottom species which concentrates in spring to nearshore for spawning. Its bigger catch at the reef with respect to the control site might be related to a greater substrate availability for egg attachment as well as to the reef protection effect.

Over the two survey years, the fish reported from the reef exceeded 25% in number and 115% in weight those obtained from the control site. Benthic and pelagic species always constituted most of the fish catch (85-96%). They were mainly original sandy-muddy bottom species (*Trigla lucerna* and Soleidae: *Solea vulgaris, S. impar, Buglossidium luteum*) as well as transient, gregarious fishes (*Sardina pilchardus, Engraulis encrasicholus* and Mugilidae: *Mugil cephalus, Chelon labrosus, Liza ramada, L. aurata, L. saliens*). Their biomass was practically the same in the catches from both sites during the first sampling year (1988), while it increased at the artificial complex in 1989. This increment was particularly appreciable with respect to *S. vulgaris* and Mugilidae and it might be in relation to the reef protection effect against trawling for the first species and to the reef attraction and aggregation effect for the second.

The only reef-dwelling benthic species of commercial value, caught exclusively and constantly at the reef site, was *Scorpaena porcus*, which gradually increased in number during the whole sampling period (11 specimens in 1988 and 14 in 1989).

The man-made structures however noticeably influenced the catch of the nekto-benthic species immediately after deployment. This group of fish was always present in a low proportion in catches at both sites during the entire survey period, but the number and weight reported from the artificial reef exceeded 3 and 4 times respectively those from the control site, in both years.

Such a difference was mainly due to the constant presence and/or increase in catch of some species of high commercial value such as Sparidae and Sciaenidae, rare by found at the control site. For example, 15 specimens of *Lithognathus mormyrus*, 1 of *Umbrina cirrosa* and 1 of *Sciaena umbra* were reported at the control site against 29, 12 and 27 respectively at the reef during the whole survey period. In particular *S. umbra*, which is a typical reef-dwelling species, drastically increased in number at the artificial complex from 1988 to 1989 (1 and 26 specimens respectively).

Table 1 - Average number of specimens and average biomass per catch for pelagic, nekto-benthic and benthic fish, crustaceans and molluscs at reef and control sites.

	1988				1989				Average 1988-89			
	Control		Reef		Control		Reef		Control		Reef	
N. catch operations	12		12		13		13		25		25	
	n.	W(g)	n.	W(g)	n.	W(g)	n.	W(g)	n.	W(g)	n.	W(g)
PELAGIC FISH	46.8	2172	44.0	2131	32.3	2618	51.3	8940	39.3	2404	47.8	5672
NEKTO-BENTHIC FISH	1.0	152	3.6	576	1.1	158	3.1	730	1.1	155	3.4	656
BENTHIC FISH	16.3	1259	15.1	1206	10.0	725	16.1	1374	13.0	981	15.6	1293
CRUSTACEANS	6.1	300	24.9	1322	108.3	5376	28.6	1560	59.2	2939	26.8	1446
MOLLUSCS	3.4	942	5.2	1515	2.4	680	3.9	1207	2.9	806	4.5	1355
TOTAL	73.6	4825	92.8	6750	154.1	9557	103.0	13811	115.5	7285	98.1	10422

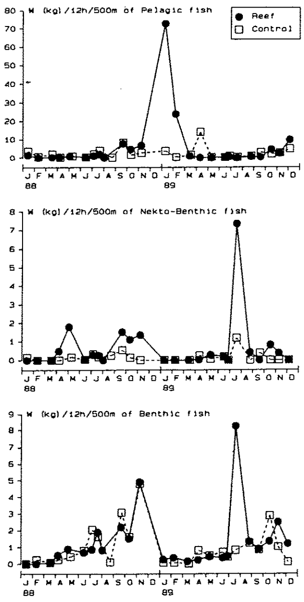

FIGURE 1 - Biomass of pelagic, nekto-benthic and benthic fish in catch at reef and control sites.

Moreover visual observations evidenced the occurrence at the reef of a higher number of reef-dwelling species as well as of individuals for each species in respect to the control site. They were nekto-benthic hard-substrate species such as *Dicentrarchus labrax, Diplodus sargus, Diplodus vulgaris*, living in shelters and/or around the lower layers of the artificial bodies, as well as pelagic reef-attracted species such as *Seriola dumerilii, Balistes carolinensis* and large schools (hundreds of individuals) of *Spicara flexuosa* and *Boops boops* swimming around the upper ends of the structures.

The influence of environmental conditions on reef effects was shown by seasonal fluctuations in fish catch recorded at both sites (Figure 1), with the lowest values for most of the species in winter, when they are assumed to migrate to deeper and warmer waters. The seasonal fish occurrence, also confirmed by visual observations, was particularly evident for the nekto-benthic fish, which appeared from spring to autumn and completely disappeared during the winter months.

Although the reef benefits seem to be reduced in winter, the higher catch values obtained from the sheltered site show that artificial reef deployment along the coast of the central Adriatic sea might be effectively useful to influence fish assemblage and to enhance nearshore fishing, with the occurrence and/or increase of selected species which are absent or rare in the original habitat (BOMBACE et al., in press).

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