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Growth of *Epinephelus guaza* under different culture conditions

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SUMMARY- Since 1992 studies about the Ecology and the Culture of different species of Groupers has been conducted in our laboratory. The most important experiments about aquaculture has been done about *Epinephelus guaza*. In this paper, results of several trials about the effect of food, salinity, temperature and the artificial hiding space on the growth and feeding efficiency of this species are presented. A growth curve of juveniles of wild groupers from 7 to 458 g.raised in 500 liters tanks is showed.

Key words: *Epinephelus*, growth, feeding eficiency, growth rate.

RESUME Depuis 1992, notre laboratoire a étudié l'écologie et la culture de différents espèces de mérou. Les expériments les plus importants ont été effectués avec *Epinephelus guaza*. Dans ce travail on présente les résultats de l'effet de l'alimentation, salinité, temperature et "cachés" artificiels sur la croissance et l'efficience alimentaire. On montre aussi la corbe de croissance des mérous sauvages dès 7 à 458 g cultivés dans bassins de 500 litres.

Mots-clés: *Epinephelus*, croissance, efficience alimentaire, taux de croissance.

INTRODUCTION

The dusky grouper, *Epinephelus guaza* like others groupers are considered by some countries as delicious and highly priced foodfish. Tradicional explotation techniques, diving and other environmental factors resulting from human activity have caused a sharp decrease in number and indeed the ocurrence of this species along our coasts is becoming rare. Landings of this species, in Spain, have decreased from 605 TM in 1978 to 0 TM in 1986 (FAO, 1991). Over the last six years, however, grouper juveniles along the coast of Barcelona have appeared in a considerable number. The objective of this paper is to illustrate the possibilities of the grouper culture studing the growth and feeding efficiency. For this purpouse, fingerlings of wild grouper were collected and stocked and after one month of acclimatization in 500 liters tanks, growth experiences started.

ANALYSIS OF DATA

The data were analysed for calculations of weight gain per fish, condition factor, survival rate, food conversion ratio, specific growth rate for weight and lenght, daily food intake rate, conversion efficiency and protein efficiency rate, as follows:

Specific growth rate
for weight: $(\text{Ln } W_t - \text{Ln } W_o) \times 100 / \text{Days}$
where, $\text{Ln } W_t$ = neperian logaritm of total weight of fish at t days; $\text{Ln } W_o$ = neperian logaritm of initial total weight of fish.

Specific growth rate
for lenght: $(\text{Ln } Lst_t - \text{Ln } Lst_o) \times 100/\text{Days}$
where, $Lnst_f$ = neperian logaritm of standard length at t days;
$Lnst_o$ = neperian logaritm of initial standard length;

Food conversion factor: dry weight of food eaten/ wet weight gained by the fish.

Daily food intake rate:
dry weight of food eaten x 100 /[1/2 $(W_t + W_o)$x days] where, W_t = total weight of fish survived in the tank at t days; W_o = initial total weight of fish in a tank.

Conversion efficiency ratio:
Weight instant growth rate x 100 / Daily intake rate

Protein efficiency rate:
wet weight gained by the fish / dry weight of protein consumed

Condition factor: $W_t \times 100 / L_t^3$

Survival rate: $N_t / N_o \times 100$
where, N_t= total number of fish at t days, N_o= initial total number of fish

FEEDING EXPERIMENT

Because the results of studies about the wild feeding, is known that Epinephelus guaza consume large quantities of octopus. After the acclimatization period, juveniles from the wild started to fed on pellets in a few days. In the first experiment the effect on the growth of different types of food, artificial commercial pellets (EWOS S.A.) and a natural one based on frozen octopus was tested. The experiment was carried out using the next variables: specific growth rate for weight and lenght, food conversion ratio, daily food intake rate, conversion efficiency, protein efficiency rate. Results of this study suggest that fish fed on artificial pellets grew faster than those fed on octopus and showed better results for the studied variables. See in table 1 the results of feeding experiment.

Table 1: Results of the variables on the growth of the grouper in the feeding experiment. Results of the artificial hiding experiment (groupers fed on octopus + mussel) are included. Statistical comparisions couldn't be made because of the different size of the fish.

	Treatment		
	Artificial pellets	Frozen octopus	Octopus + mussel
Specific growth rate for weight (%)	1.416	1.234	0.91
Specific growth rate for lenght (%)	0.54	0.444	0.338
Food conversión ratio	1.3	5.4	6.5
Daily food intake rate (%)	1.53	5.87	7.37
Conversion efficiency ratio (%)	92	21	12.4
Protein efficiency ratio	1.5	1.85	1.89

SALINITY EXPERIMENT

Some species of groupers live at salinities lower than sea waters, like *Epinephelus tauvina* in Philippines at 3-27‰ (Manzano,1985). We try to know if *Epinephelus guaza* can resist different values of salinity, like the grouper mentioned above, and which are the response through the growth to their culture conditions.

Three salinities (35, 27 and 20‰) were studied using the variables from the former experiment and survival rate. Results showed that fishes at salinity of 20 and 27‰ grew slower and showed worst results for the studied variables as those at salinity of 35‰ at the end of the experience. However, fishes at salinity of 27‰ grew equally fast and showed comparable results as those at salinity of 35‰ at the first 30 days but survival was lower than the fishes at 35‰ .

Fishes maintained at 27‰ shown a big change in relation to the results in the first 30 days. Survival decrease to 85% and the results of growth were worst as those at day 30. The specific growth rate decreased from 0.7 to 0.23 and the food conversion ratio decreasing from 1.86 to 3.86.

Treatment at 20‰ had the worst results of growth during the experience. The weight gain per fish were 10.92, 5.99 and 5.58 g. for the treatments at 27, 35 and 20 ‰ respectively. The condition factor maintained regular from the start to the end of the experiment for each treatment. See in table 2 the results of salinity experiment.

Table 2: Results of the variables on the growth of the grouper in the salinity experiment.

	Treatment					
	35‰		27‰		20‰	
Day	30	45	30	45	30	45
Specific growth rate for weight (%)	0.54	0.51	0.70	0.23	0.16	0.25
Specific growth rate for lenght (%)	0.10	0.08	0.12	0.04	0.06	0.04
Food conversión ratio	2.03	1.29	1.86	3.86	4.68	3.92
Daily food intake rate (%)	0.85	0.65	0.97	1.47	0.65	1.6
Conversion efficiency ratio (%)	63.1	78	71.8	15.6	24.2	14.9
Protein efficiency ratio	0.99	0.63	0.91	0.52	2.29	1.92
Weight gain per fish		11.92		5.99		5.58
Condition factor		2.89		2.74		2.71
Survival (%)		100		85		71.5

TEMPERATURE EXPERIMENT

Some species of groupers live in waters warmer than the Mediterranean sea. We try to know whether *Epinephelus guaza* can resist different values of temperature and which are the response through the growth to this culture conditions.

Two temperatures (25.9±1.8° C and 20.4±1° C) were studied using the former variables. Salinity of 35‰ was used in both treatment because it shown the best growth results in the last experiment. Results of this study indicate that fish at temperature of 25.9±1.8° C had faster growth and showed better results in all the studied variables that fishes maintained at a temperature of 20.4±1° C. Increase in biomass for the fishes at high temperature were 93.16% higher than fishes at low temperature. This temperature level is lower than the 27-31°C reported for *Epinephelus salmoides* (Chua et al., 1980) and the 26-39°C reported for *Epinephelus tauvina* (Manzano,1985). Optimal temperature in order to get the best results on the growth of this specie can be higher than 25.9±1.8°C. See in table 3 the results of temperature experiment.

Table 3: Results of the variables on the growth of the grouper in the temperature experiment.

	Treatment	
	High temperature	Low temperature
Specific growth rate for weight (%)	0.48	0.33
Specific growth rate for lenght (%)	0.16	0.09
Food conversión ratio	1.67	2.03
Daily food intake rate (%)	0.9	0.8
Conversion efficiency ratio (%)	54.8	41.1
Protein efficiency ratio	0.82	0.99
Weight gain per fish	31.1	16.6
Condition factor	2.67	2.88
Survival(%)	100	100

ARTIFICIAL HIDING SPACE

The effect of the artificial hiding space on the growth were studied. After 90 days not significant differences were found between both considered treatment for the studied variables. In this experiment the feeding was frozen octopus and mussel. Results are showed in table 3. Results were lower than fishes which fed on pellets and octopus. Statistical comparisions couldn't be done due to the different size of the fish. The grouper's social activity during intensive growth does not present problems, but may become an important factor at later stages or at higher densities than 3.3 Kg/ m^3.

GROWTH CURVE

A growth curve, feeding efficiency and biometry of the grouper was carried out in captivity. The growth curve was realized during 450 days between 1992 and 1994, in three succesive experiments, using fish stocks of different weight. The mean initial weight of the fish in each period of 90, 162 and 198 days was 7, 25 and 96 g. and the mean final weight was 25, 96 and 458g. respectively. The relationship between growth and time was $Y=\exp^{(2.264+0.00827\ X)}$. The temperature was 24.1 ± 1.9° C during the experiment. Growth and feeding efficiency were studied in all the curve. Fishes spent 15 month from 7 to 458g. The weight instant growth rate was 1.0%, the food conversion ratio 1.23, the daily intake rate 1.09%, the protein efficiency rate 1.64, the feeding efficiency 93.8% and the condition factor 2.86. See table 4 and fig. 1 for more details.

Table 4: Results of the variables on the growth of the grouper in the growth curve.

CF: CONDITION FACTOR, SGR: SPECIFIC GROWTH RATE, FCR: FOOD CONVERSION RATIO, DFI : DAILY FOOD INTAKE RATE, PER : PROTEIN EFFICIENCY RATIO, CER : CONVERSION EFFICIENCY RATIO.

WEIGHT(g.)	CF	SGR(%)	FCR	DFI(%)	PER	CER(%)
7-25	2.98	1.4	1.3	1.62	1.56	87.5
25-96	2.6	0.83	1.2	0.86	1.7	96.5
96-458	3.01	0.78	1.21	0.8	1.68	97.5
7-458	2.86	1.0	1.23	1.09	1.64	93.8

Fig. 1 : Growth curve of the grouper, Epinephelus guaza under culture conditions.