

EXPERIMENTAL FEEDING AND GROWTH OF TURBOT (SOPHTHALMUS
MAXIMUS L.) FROM 0.5 TO 2.7 KG IN GALICIA (SPAIN)

by

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ABSTRACT

Two groups of turbot, Scophthalmus maximus L., of 0.5 and 1.2 kg initial mean weight were fed a semimoist diet containing fish, fish meal and vitamin-mineral complex. The trial was carried out in tanks of 16 cubic meters, for a period of a year. Results on feed conversion index and growth in weight are given.

RESUME

Deux groupes de turbot, Scophthalmus maximus L., d'un poids moyen initial de 0.5 et 1.2 kg ont été alimentés avec une régime semi-humide que contient du poisson, farine de poisson et un complexe de vitamines et minéraux. L'expérience a été menée dans des bassins de 16 mètres cubiques pendant une période d'une année. On donne les résultats du taux de conversion et croissance en poids.

INTRODUCTION

In recent years, the excellent qualities of turbot (Scophthalmus maximus L.) as a species for fish cultivation have been demonstrated (JONES et al., 1981). Its high growth rate, easy handling, the possibility of working with high stock densities due to its low level of oxygen consumption (BROWN et al., 1984) plus the low mortality rate and its high market price are all factors contributing to its cultivation value.

The marine environmental conditions on the coasts of Galicia (NW of Spain) are very suitable for the cultivation of turbot: sea water temperature ranges between 12°C and 20°C and salinity values are very constant (32 - 35‰). This leads to very good results in the growth of this species, which reaches a commercial market size in less time than in northern, colder European waters.

There is much data available concerning the rate of growth of turbot from the weaning stage to 0.5-1 kg final weight (PURDOM et al., 1972, SMITH 1976, POXTON et al., 1982). Some authors have reported growth rates in larger sizes (PERSON et al., 1980). Studies carried out by Iglesias et al., 1987, analyze the growth of two groups of turbot reaching final weights of 1.2 and 1.9 kg.

This paper reports the results obtained in a period of a year, working with two groups of turbot belonging to two different size classes with initial mean weights of 1.2 and 0.5 kg, the objective being to determine what the rate of increase in weight of adult turbot is, under pilot-scale farming conditions.

MATERIAL AND METHODS

The trials were carried out in the Fish Farming Research facilities of the Spanish Institute of Oceanography in Vigo.

Two groups of turbot having 1.2 kg (group A) and 0.5 Kg (group B) mean wet weights at the beginning of the ongrowing experiment, were measured to the nearest cm (the next lowest) and weighed to the gram, every two months. Group A consisted of 109 individuals and group B of 123. The turbot were kept in two polystyrene tanks holding 14 cubic meters of sea water each, in open circuit. The tanks were square with rounded corners, having a central outlet and airlifts in the corners to maintain a centripetal current for self-cleaning purposes. The water flow was 0.01 cubic meter per kg of fish, per hour.

The turbot were fed once a day, in the morning. They were kept under low natural light intensity during most of the day. Artificial light was switched on only before and during the food intake. The ration of food supplied was calculated as a percentage of their mean weights, and it was constant between measurements (every two months). Uneaten food was recorded daily.

The diet consisted of a moist paste, cylinder shaped, of 22 and 28 mm diameter. The same ingredients were used from the beginning to the end of the trial. These were: chopped blue whiting (Micromesistius poutassou Risso), fish meal with a high protein content, and a vitamin-mineral complex. Percentages and chemical composition are given in Table I. The food was made every 3-4 days and kept in a refrigerator at 3°C. The fish were given a prophylactic bath in formaline and green-malachite treated water every two months.

Ingredients	%	Analysis	%
Chopped blue whiting	46.5	Moisture	43.0
Fish meal	46.5	Protein	38.5
		Lipids	4.7
Vitamin-mineral	7.0	Ash	10.1

Table I: Turbot diet: composition in percentages

RESULTS AND DISCUSSION

Mean weights are given in Table II. The increase in weight in the two groups studied remains very constant throughout the whole period. Group A gained a total amount of biomass of 1454.7 gr reaching a final weight of 2722.3 gr, while in group B the values were 1404.2 gr and 1915.7 gr. Figure 1 shows the rate of increase in mean weight with time. The rate of increment is very constant and can be considered lineal, the most noteworthy being that older fish (group A) achieve the same weight increment as younger ones - (group B). Eight months is the period needed to gain 1 kg in both groups. This high growth rate can be considered a very good record if compared with data reported from other authors in northern European countries (PERSON et al., 1980).

Apparently, no relationship between temperature and rate of growth has been observed in these trials; the fish accepted the food fairly well in any season. This fact could be due to the narrow range of extreme values of temperature recorded throughout the year (see Table II).

TABLE II

Month	No. of fish		(1) Mean weight		(2) Conversion index		(3) Stocking density		(4) Temp.
	A	B	A	B	A	B	A	B	(°C)
Jun.	109	123	1267.6	511.5	----	----	9.9	4.5	17.6
Aug.	108	123	1620.2	797.1	2.87	1.92	12.5	7.0	18.2
Oct.	106	121	1822.3	988.1	4.49	2.49	13.8	8.5	17.5
Dec.	106	118	2107.7	1223.1	3.34	2.24	16.0	10.3	14.0
Feb.	106	116	2336.4	1556.2	3.41	2.12	17.7	12.9	13.0
Apr.	64*	116	2499.1	1763.4	3.04	3.13	11.4	14.6	14.1
Jun.	64	116	2722.3	1915.7	3.35	3.62	12.4	15.9	17.3

1. Expressed in grams
2. Food consumed/weight gained
3. Biomass (kg/volume of sea water (cubic meters))
4. Mean monthly values

(*) 42 fish were selected for broodstock and transferred to another tank

Values of food conversion indexes (food ingested/weight gained) are given in Table II. They are very constant for the whole period in group A, ranging from 2.87 to 3.41 (the abnormal value of 4.49 in October was due to incorrect administration of food). In group B they are slightly better, tending to increase with age: 1.92 at the beginning of the trial, which was the best value recorded for both groups, and 3.62 at the end.

Stocking densities are shown in Table II. They were rather low in both tanks with group A ranging from 9.9 to 12.4 kg m⁻³ with a maximum of 17.7 in February, and group B values being 4.5 kg m⁻³ at the beginning of the experiment, and 15.9 at the end. The reason for maintaining these low stocking densities was that the fish were being kept not only for ongrowing but for broodstock renewal purposes as well. When taking into account similar growth rate results working with densities from 4 to 75 kg m⁻³ (IGLESIAS et al., 1981), it can be concluded that the rate of growth achieved with the stocking densities reported in this paper can also be obtained with higher ones (such as the 30 kg m⁻³ which is usual in turbot farms in Galicia).

Mean length values, standard deviations and percentages of increment in length are given in Table III. The larger turbot (group A) with an initial mean length of 38.90 cm reach a final size of 48.22 cm while the younger ones (those in group B) go from 29.32 cm to 43.11 cm in the same twelve-month period.

TABLE III

Month (day)	Mean Length (s.d.) ⁽¹⁾		increase in length (%)	
	A	B	A	B
Jun. (0)	38.90 (3.72)	29.32 (3.27)	---	---
Aug. (60)	41.56 (3.08)	33.44 (3.06)	6.8	14.0
Oct. (123)	43.18 (3.16)	35.81 (3.24)	3.9	7.1
Dec. (180)	44.82 (3.14)	38.18 (2.90)	3.8	6.6
Feb. (247)	46.05 (3.28)	40.78 (3.05)	2.7	6.8
Apr. (313)	47.33 (3.47)	42.09 (3.28)	2.8	3.2
Jun. (367)	48.22 (3.56)	43.11 (3.49)	1.9	2.4

(1) Expressed in cm

In contrast to what was observed in the weight increase, which is lineal in both groups during the period considered, a slight tendency towards stabilization in growth can be noted from about the size of 42 cm onwards. However, this observation has only a relative significance given the fact that the number of fish studied was low and that no separation was made between males and females which, as has been shown (JONES, 1974), have a different growth rate at these ages.

The mortality rate is low in both cases: 2.7% in group A and 5.7% in group B. No severe diseases were observed in the period studied.

CONCLUSION

The results presented in this paper indicate that the increase in weight in large size turbot (> 1kg) remains very constant until reaching almost 3 kg, which corresponds to three years in captivity in Galician waters. Low mortalities, reasonably good food conversion indexes, higher market prices in large size turbot together with the possibility of using them as future broodstock indicate that prolonging the period of on-growing can be profitable under industrial farming conditions.

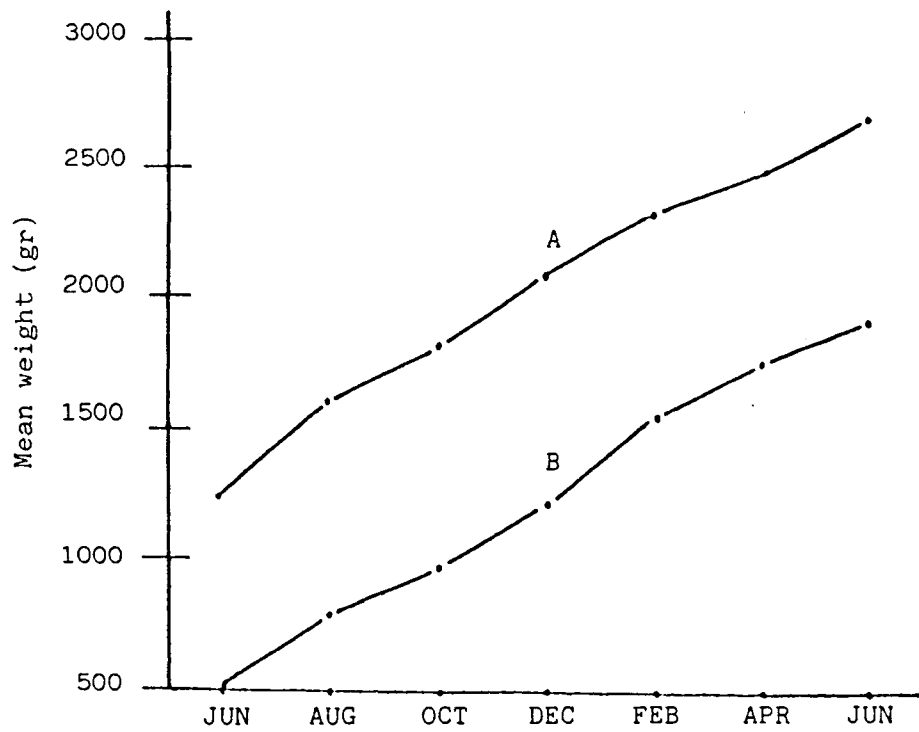


Fig. 1: Growth in mean weight in a period of a year in two groups of turbot with initial mean - weights of 1267.6 gr (group A) and 511.5 gr (group B).

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