Abstract – We show experimentally a linear dependence of target strength (TS) of gilthead sea bream, measured in sea cages, with the logarithm of the total length of fish. This relationship is obtained for the ventral aspect of TS of the gilt-head sea bream, measured by a low cost single-beam device. And it allows us to remotely monitor the growth of fish in sea cages.

Keywords - Target strength, Sparus aurata, sea cage, ventral aspect, physoclist.

1. INTRODUCTION
The aim of this study is to establish a relationship between target strength (TS) and total body length of the gilthead sea bream (Sparus aurata), which allows us to monitor their growth in sea cages. The estimated growth rate and biomass are crucial factors in the production plan and the management of marine farms. The gilthead sea bream is one of species of greatest economic interest in Mediterranean basin, and together with European sea bass (Dicentrarchus labrax) represent 95% of Spanish fish production.

2. MATERIALS AND METHODS
Five classes of commercial size gilthead sea bream are characterized from 20 to 25 cm (160 to 270 g). Firstly, we measure total length and mass of each of the specimens, previously anesthetized. Then a few specimens are introduced into a sea cage of 3 m in diameter and 2.7 high. We use two equipment to perform the acoustic measurements. We measure the TS directly using a Simrad EK60 echo sounder with a 7º split-beam transducer working at 200 kHz. Furthermore we use a low cost single-beam system, which allows us to record the full waveform with a high sampling rate, with a 30º single-beam transducer working at 200 kHz. Measurements are made for both ventral and dorsal aspect of fish, using both of measurement systems. The records are made with a transducer located in the center of the cage, at the bottom facing upwards for ventral measurements and on the surface facing down to perform dorsal measurements.

3. RESULTS
We perform two analysis based on single echo detection. The first examines all available information concerning the amplitude and the arrival angle of echoes (split-beam analysis), obtaining absolute values of TS. While the second analysis omit the phase information (single-beam analysis), obtaining values of uncompensated TS (TSu). In the single-beam analysis we develop two algorithms, which differ in the order in which criteria are applied to detect single echoes. TS distributions obtained from the split-beam analysis are unimodal for both ventral and dorsal measurements, like with the TSu when you apply first the threshold criterion. We found a linear relationship between mean TS and logarithm of total body length of fish for the ventral aspect, which presents good correlations for both TS and TSu, even having a few detections. Note that the relationship between mean TSu and total body length allow us to monitor the growth of gilthead sea bream using a low cost single beam equipment. However the goodness of fit can be severely affected by noise and / or near-field errors.

REFERENCES

Fig. 1. Detail of mounting of the transducer at the bottom of the sea cage for the ventral measurement of TS on gilthead seabream.