

# Turbot (*Scophthalmus maximus*) – Current status of selective breeding in Europe

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## Table of Contents

1. Introduction.....	1
2. Characteristics of breeding companies .....	2
Acknowledgements .....	2
References.....	2

### 1. Introduction

With an annual production over 12 thousand tonnes, turbot (*Scophthalmus maximus*) is an important aquaculture species in Europe (FEAP, 2014a). Spain and Portugal are the major producers of turbot (table 1). Two breeding companies are located in Spain and one in France and together they were responsible for all juvenile production in 2012. According to Cabaleiro (2015) the reported juvenile production in Spain is too high and this figure should rather be 17 million.

**Table 1. European turbot production volume and value in Europe in 2012**

Country	Production volume <sup>a</sup> (tonnes)	Production volume <sup>b</sup> (tonnes)	Production value <sup>b</sup> (1000 €)	Juvenile production <sup>c</sup> (million)
Denmark	-	2	19	-
France	250	300	2 852	1.26
Iceland	1	28	240	-
Netherlands	-	180	1 351	-
Portugal	4 500	4 406	20 369	-
Spain	7 970	7 758	37 286	18.95
Total	12 721	12 675	62 116	20.21

<sup>a</sup> (FEAP, 2014a)

<sup>b</sup> (FAO, 2014)

<sup>c</sup> (FEAP, 2014b)

Reviews on turbot aquaculture and selective breeding are provided by Danacher and Garcia-Vazquez (2007) and by Bouza et al. (2014). Aquaculture production of turbot first started in the 1970's and the industry's development accelerated in the early 1990's with the improvement of juvenile production techniques (Danacher & Garcia-Vazquez, 2007). European aquaculture production reached 12 675 tonnes in 2012 (FAO, 2014). The first breeding programs for turbot started in 1993 by France Turbot and in 1995-1996 by Stolt Sea Farm. For the first selected generations, the genetic gain on growth performance was 10-15% per generation. Sexual maturity is reached at an age of two years in males and three years in females (Danacher & Garcia-Vazquez, 2007). However it takes another 1.5-2 years until broodstock is fully adapted to a photo-thermal regime and the egg quality and fecundity are optimum. Therefore the generation interval is four to five years (Cabaleiro, 2015). Although much of the research that has been performed on selective breeding of turbot was included in the above mentioned reviews, a description of the main characteristics of breeding companies is lacking. The three companies that operated breeding programs for turbot in 2012 were the only companies that reproduced turbot, hence all turbot production in Europe originates from breeding companies. This report describes the main characteristics of these breeding companies.

## 2. Characteristics of breeding companies

In collaboration with AQUATRACE<sup>1</sup>, questionnaires were distributed among the three breeding companies in Europe. The questionnaire included questions related to the type of selection, the number of selected generations, selected traits, the application of genetic markers and genomic selection and the monitoring of inbreeding. All three companies participated in the survey.

One breeding company performed mass selection and two performed family selection. All companies selected on growth performance and other selected traits were disease resistance and morphology. The reported number of selected generations ranged from three to five. All companies monitored the rate of inbreeding by the use of genetic fingerprints for parentage assignment. Artificial fertilization was applied in order to secure a balanced contribution of parents, as in mass spawning events the contribution of parents can be highly skewed. Marker assisted selection and genomic selection were not applied.

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<sup>1</sup> AQUATRACE - <https://aquatrace.eu/> - 7<sup>th</sup> Framework Programme for research (FP7)