

**REPORT OF THE
WORKING GROUP ON MARINE FISH CULTURE**

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1 MEMBERS

The current membership of the Working Group is as follows:

Australia:	K. Williams
Belgium:	P. Coutteau, P. Lavens, P. Sorgeloos
Denmark:	O. Bagge, I. Fjallstein, P. Laussen, A. Nissling, J. Støttrup
Canada:	J. Castell, J. Gagné, R. Penny, K. Waiwood
Finland:	A. Soivo
France:	B. Chatain, J. Person-le-Ruyet
Germany:	M. Bleil
Iceland:	B. Bjornsson, G. Marteinsdottir
Ireland:	R. Fitzgerald
Norway:	D. Danielssen, A. Mangor-Jensen, E. Moksness, I. Opstad, S. Sundby
Portugal:	J. Menezes, P. Pousao
Spain:	J. Iglesias, C. Fernández-Pato
Sweden:	H. Ackefors, J. Andersson, P. Larsson
U.K.:	M. Gillespie, B. Howell, R. Johnstone, A. Munro

2 TERMS OF REFERENCE

The following terms of reference were approved by the Council (C. Res. 1995/2:32) during the 1995 Annual Science Conference in Aalborg, Denmark:

The Working Group on the Mass Rearing of Juvenile Marine Fish will be renamed the **Working Group on Marine Fish Culture** (Chairman: Dr B.R. Howell, UK) and will work by correspondence in 1996 to plan a meeting in 1997 to:

- a) report on the current status of marine fish cultivation in ICES Member Countries and on the factors which are likely to constrain the further development and sustainability of the industry;
- b) report on research into the characteristics of reared fish and reappraise the potential for establishing quality assessment criteria;
- c) report on the current and continuing availability of live foods for larval marine fish and review the prospects for their replacement with formulated feeds;
- d) assess the impact of recent advances in the development of alternative on-growing systems for marine fish;
- e) evaluate the effects on larval performance of alterations to biotic and abiotic environmental variables;
- f) report on developments in fish welfare issues and assess their impact on marine fish cultivation practices.

3 ACTIVITIES OF THE WORKING GROUP

3.1 Introduction

The re-named Working Group did not meet during 1996/7 but worked by correspondence to plan its first meeting in 1997. The principal activity was the collection and collation of information on the current status of marine fish culture in ICES Member Countries during 1995 [Terms of Reference item a)]. Dr Støttrup (Denmark) co-ordinated this task while

other members/participants in the activities of the Working Group have undertaken to coordinate the other activities identified within the terms of reference. These are identified in the subsequent sections of this report.

3.2 Marine Fish Production in 1995

Production data was sought from each country represented on the Working Group but in order to obtain a more complete perspective on sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) production it was decided to extend the collection of data on these species to non-ICES Mediterranean and Black Sea countries. Dr. Krishen Rana (FAO) kindly provided the available data on the production of market-sized fish for the period 1984 to 1994. Data on juvenile production were not available. The comments which follow are thus based on the data provided by members of the Working Group and by Dr. Rana.

3.2.1 Production of juveniles.

The data are shown separately for those species predominantly used for intensive aquaculture (Table 1) and those predominantly used for stocking (Table 2). In accordance with earlier observations, there was little overlap between the two groups. A significant feature of the data, however, is that in 1995 there was a reduction in the range of species and numbers reared for stocking compared to previous years. Thus, in 1995 the number of species used predominantly for stocking was reduced from 5 to 3 species, and the demand for juveniles for stocking comprised less than 0.5% of the total production of juveniles. This may reflect a change in policy toward stock enhancement programmes.

The total production of juveniles in 1995 was just below 60 million. Excluding cod production, a total decrease of around 26% was observed in the other species, more specifically in halibut and sea bass. The major producers were France and Spain, contributing over 95% of the total production, and the main species were sea bream, sea bass and turbot. No production of sole was reported though it is known that juvenile production in southern Spain exceeded 1 million.

Turbot juvenile production seems stable in most countries though slightly lower in 1995 in Norway and UK reflecting, perhaps, a shift in effort to halibut as rearing methods for that species develop. Earlier marketing problems with turbot juveniles are now less evident and no other specific problems were identified by respondents though the incidence of abnormal pigmentation among intensively reared fish remains at an unacceptable level. The total production of halibut *Hippoglossus hippoglossus* fell by around 75% from 1994 to 1995 and was primarily attributed to outbreaks of Viral Encephalopathy and Retinopathy (VER) in the Norwegian stock. In the UK, the production of this species remains relatively low but is increasing significantly.

The production of sea bass was almost halved due reportedly to the closure of a hatchery in France. In contrast, sea bream production in Spain almost doubled. No specific factors were identified as limiting for the further development of the culture of these species.

In contrast to previous years, the production of cod (*Gadus morhua*) in 1995 was predominantly for aquaculture purposes, relatively few (20 000) being produced for stocking purposes. Total production, however, was about 40% lower than in 1994. In Denmark, the cod stocking programme completed its final year and, after an evaluation of

the results, was discontinued. The number of plaice produced for stocking has increased due to improved culture techniques. The demand for juveniles of this species as well as for juveniles of flounder will, in the future, primarily depend on decisions relating to stocking strategies. The rearing methods for both these species, however, still need further improvement to eliminate problems perceived to be nutritionally related. The production of whitefish for stocking has remained stable but is expected to increase in future.

3.2.2 Production of market-size fish.

The production of market-size fish in ICES countries was predominantly sea bass and sea bream produced primarily in France and Spain. Several factors limiting the expansion of the production of these species were identified. Among these were access to sites, nutritional problems, pathology, production costs in relation to market price and early maturation problems.

The data supplied by FAO provide an overview of the development of sea bass and sea bream production in the countries around the Mediterranean and Black Sea (Table 4), complementing the data provided in Table 3. The production of these species in Italy has increased almost ten-fold from 1984 to 1994. Italy was the dominant producer in 1984, producing around 300 MTs, but has since been overtaken by Greece which in 1994 was the leading producer of both species with a production of 6870 t of sea bass (almost 50% of the total production) and 6500 t of sea bream (about 30% of the total production). Figure 1 shows the increase in total production of these two species during the period 1984-94. Whereas the rate of increase of sea bass production seems to have slowed down by 1994, seabream production was still increasing exponentially.

The 1995 production of halibut was almost double that of 1994 and is expected to increase further. Around 500 t of wild caught cod were sold in 1995 after being kept in net pens for 6-8 months. These were not included in the production data in Table 3. The production of turbot continues to increase at a steady rate of around 20-25% over the past 3 years.

3.3 Preparation for the 1997 meeting of the Working Group

There was a consensus at the 1995 meeting that the first meeting of the renamed Working Group should be in Murcia, Spain during June 1997. This would perhaps lead to greater participation of those with interests in sea bass and sea bream rearing thereby negating the bias towards more northern species which was felt had pervaded previous discussions of the Working Group.

The principal topics to be considered at the next meeting were selected at the 1995 meeting because of their current relevance to the further development of marine fish culture in ICES Countries. These were:

- a) Current status and constraints
Co-ordinator: Dr J Støttrup (Denmark)

The now established practice of reviewing the current status of marine fish cultivation in ICES Member Countries will be continued. An important aspect of this activity is the

identification of factors likely to constrain the future development and sustainability of the industry. This will permit key issues to be identified which should form part of the agenda of future meetings of the Working Group.

- b) Characteristics of reared fish
Co-ordinator: Dr B Howell (UK)

The importance of the effect of rearing conditions during the early developmental stages on subsequent characteristics is now well recognised. Previous discussions, however, concluded that standardised tests for juvenile quality can not yet be established. Recent investigations of juvenile quality will be reviewed and the prospect for establishing quality criteria will be assessed.

- c) Availability of live feeds and their replacement with formulated feeds
Co-ordinator: Drs P Lavens and P Coutteau (Belgium)

The production of juvenile marine fish remains critically dependent on both the availability and quality of live foods. The current situation regarding the use of live foods and the prospects for their replacement with formulated feeds will be reviewed.

- d) Alternative on-growing systems to those commonly used
Co-ordinator: Prof V Øiestad (Norway)

The development of farming methods for marine fish has been mainly based on intensive cage or open-flow tank systems and is constrained in many countries by climatic conditions and the availability of suitable coastal sites. Technological developments in the field of recycling systems or the development of semi-extensive systems, for example, may alleviate some of these constraints. The current status of these approaches will be appraised.

- e) The importance of biotic and abiotic environmental variables
Co-ordinators: Prof. Y Olsen (Norway) and Dr J Verreth (Holland)

At the last meeting of the Working Group it was concluded that a better understanding of the effects of environmental variables was vital to rearing success. In particular, it was thought that although microbiological development and the degree of interaction between biotic and abiotic parameters during larval development are poorly understood, their proper control is probably critical. Recent work directed towards a better understanding of the interaction between larvae and their environment will be reviewed.

- f) Welfare issues
Co-ordinator: Mr R Johnstone (UK)

The Council of Europe is likely soon to consider the welfare of farmed fish which might ultimately result in EC welfare legislation. In the knowledge of this development, in 1992 the UK Government asked an independent advisory body, the Farmed Animal Welfare Council, to prepare a report that it might use in its negotiations. The group sought evidence via a large number of visits to UK aquaculture operations, mostly involving the rearing of trout and salmon. They also visited Norway. This report, which is understood to

be the first of its kind but which has not yet been made public, has recently been delivered to UK Ministers. It is expected to make a number of recommendations on a range of issues including environmental concerns, mechanical handling, health and medicinal compound issues, pre-harvest fasting practices and methods of killing. The majority of these recommendations are expected to reflect good practice and are not expected to place too heavy a burden on industry.

A review of the latest developments in this area will be presented at the next meeting of the Working group.

4 RECOMMENDATIONS

The Working Group on Marine Fish Culture recommends that it meets in Murcia, Spain from 23-26 June 1997 with Dr B R Howell as Chairman to:

- a) report on the current status of marine fish cultivation in ICES Member Countries and on the factors which are likely to constrain the further development and sustainability of the industry;
- b) report on research into the characteristics of reared fish and reappraise the potential for establishing quality assessment criteria;
- c) report on the current and continuing availability of live foods for larval marine fish and review the prospects for their replacement with formulated feeds;
- d) assess the impact of recent advances in the development of alternative on-growing systems for marine fish;
- e) evaluate the effects on larval performance of alterations to biotic and abiotic environmental variables;
- f) report on developments in fish welfare issues and assess their impact on marine fish cultivation practices.

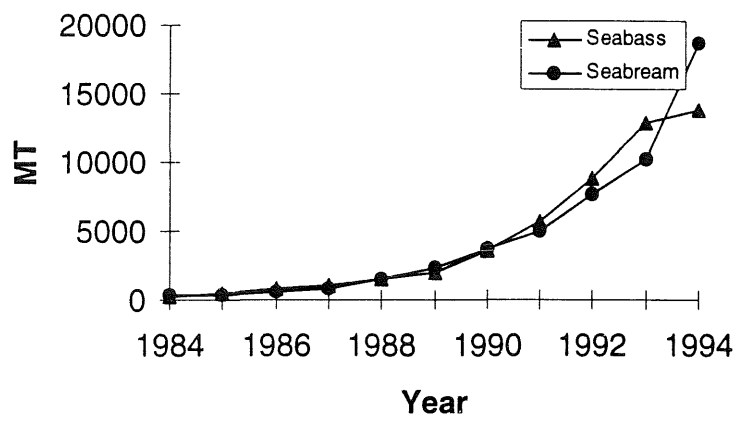


Figure 1. Production of European seabass *Dicentrarchus labrax* and gilthead seabream *Sparus aurata* during 1984-1994 in the Mediterranean and Black Sea. Source FAO.

Table 1. Production ('000s) of juvenile marine fish in ICES countries in 1995: species primarily, though not exclusively, used for intensive cultivation. Data for 1994 are given in parenthesis.

COUNTRY	HALIBUT <i>Hippoglossus hippoglossus</i>	TURBOT <i>Psetta maxima (Scophthalmus maximus)</i>	SEA BASS <i>Dicentrarchus labrax</i>	SEA BREAM <i>Sparus aurata</i>	COD <i>Gadus morhua</i>	TOTAL
DENMARK		505.5 (502)			11.4 (11)	516.9
FINLAND						0
FRANCE		1800 (1650)	14900 (30056)	5200 (5400)		21900
ICELAND	3		110		2	115
NETHERLANDS						0
NORWAY	85 (400)	250 (411)			162 (270)	497
POLAND						0
SPAIN		1500 (1028)	3920 (4035)	30100 (17675)		35520
UK	15 (2)	100 (250)				115
TOTALS	103 (402)	4155 (3841)	18930 (34091)	35300 (23075)	175 281	58663.9
% CHANGE	-74	8	-44	53	-38	

Table 2. Production ('000s) of juvenile marine fish in ICES countries in 1995: species primarily, though not exclusively, used for stocking. Data for 1994 are given in parenthesis.

COUNTRY	FLOUNDER <i>Pleuronectes flesus</i>	PLAICE <i>Pleuronectes platessa</i>	WHITEFISH <i>Coregonus lamaretus</i>
DENMARK	1.1	284 (40)	
FINLAND			70 (65)

Table 3. Production (tonnes) of farmed marine fish in ICES countries in 1995. For comparison, data for 1994 are given in parenthesis.

COUNTRY	HALIBUT <i>Hippoglossus hippoglossus</i>	TURBOT <i>Psetta maxima (Scophthalmus maximus)</i>	SEA BASS <i>Dicentrarchus labrax</i>	SEA BREEM <i>Sparus aurata</i>	COD <i>Gadus morhua</i>	TOTAL
DENMARK		5 (30)				5
FINLAND						0
FRANCE		800 (630)	2300 (2193)	1300 (1158)		4400
ICELAND	10 (20)				33 (70)	43
NETHERLANDS		11				11
NORWAY	80 (30)	50 (40)				130
POLAND						0
SPAIN			709 (351)	3790 (2094)		4499
UK						0
TOTAL	90 50	866 700	3009 2544	5090 3252	33 70	9088
% CHANGE	80	24	18	57	-53	

Table 4. Production of European sea bass (*Dicentrarchus labrax*) and gilthead seabream (*Sparus aurata*) from 1984 to 1994 in the Mediterranean and Black Sea. Data provided by FAO.

Dicentrarchus labrax

European seabass

Mediterranean and Black Sea

¹ Northeast Atlantic

Country / Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Cyprus	1	1	1	0	3	10	15	15	29	33	20
Algeria	2	4	5	6	7	5	2	4	3	6	5
Egypt	0	0	0	0	0	0	0	720	720	1139	720
Spain ¹	0	11	31	38	29	24	31	92	143	370	351
France	0	70	90	140	145	250	300	414	550	1330	2138
Greece	0	0	90	70	110	300	1952	2530	5043	7345	6870
Israel	0	0	0	0	0	0	0	0	0	75	145
Italy	280	340	550	750	930	1100	1050	1538	1826	2000	2850
Morocco	0	0	0	0	0	0	0	56	121	120	107
Malta	0	0	0	0	0	0	0	150	350	400	350
Slovenia	0	0	0	0	0	0	0	0	0	0	34
Tunisia	2	15	30	40	316	300	283	305	161	419	571
Total ex. Spain	285	430	766	1006	1511	1965	3602	5732	8803	12867	13810
Total	285	441	797	1044	1540	1989	3633	5824	8946	13237	14161

Figures are expressed in MT

Sparus aurata

Gilthead seabream

Mediterranean and Black Sea

¹ Northeast Atlantic

Country / Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Cyprus	0	0	0	2	2	16	35	42	42	136	187
Algeria	1	0	0	0	0	0	2	1	0	1	1
Egypt	0	0	0	0	0	0	0	720	720	720	720
Spain ¹	0	127	124	109	153	344	565	1073	1675	2014	2094
France	5	15	10	10	170	20	30	40	100	329	1153
Greece	0	0	0	65	220	490	1598	2069	4126	6012	6500
Croatia	0	0	0	0	0	0	0	0	45	30	70
Israel	0	0	30	45	60	80	84	71	54	155	555
Italy	320	360	450	550	750	850	850	965	1070	1300	2600
Morocco	0	0	0	0	0	0	0	96	254	255	200
Malta	0	0	0	0	0	0	0	50	150	250	550
Slovenia	0	0	0	0	0	0	0	0	0	0	40
Tunisia	15	5	20	25	194	120	85	3	131	52	38
Turkey	0	0	34	65	100	798	1031	910	937	1029	6070
Total ex. Spain	341	380	544	762	1496	2374	3715	4967	7629	10269	18684
Total	341	507	668	871	1649	2718	4280	6040	9304	12283	20778

Figures are expressed in MT

