INTERNATIONAL COUNCIL FOR
THE EXPLORATION OF THE SEA

~C.M. 1990/E:20/Ref. G
~Marine Environmental Quality Committee~

ON THE FREQUENCY OF LEFT-SIDED INDIVIDUALS IN EUROPEAN FLOUNDER (*PLATICHTHYS FLESUS*) POPULATIONS IN RELATION TO POLLUTION MONITORING

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ABSTRACT

The European flounder (*Platichthys flesus*) is commonly used by scientists of ICES countries in the monitoring of pollution of coastal and estuarine areas. Flounder is one of the few flatfish species, where both right-sided (normal) and left-sided (reversed) individuals can be commonly observed. This paper describes the frequencies observed in different local stocks and age groups in Dutch coastal waters. Further, indications were found of a higher selective mortality and morbidity, and a lower enzyme induction activity (EROD) in reversed fish.
It is recommended that the feature of normal/reversed phenotype should be recorded in sampling programmes, because it might prove a potentially useful index for monitoring environmental deterioration.

1. INTRODUCTION

The European flounder (*Platichthys flesus*) lives on soft sediments in the coastal waters of the eastern Atlantic Ocean. The flounder is an euryhaline species *par excellence*: the life cycle of each individual usually includes marine, brackish and fresh water habitats. Young flounders hatch at sea; during their development to mature fish they live in the shallow coastal zone, especially in estuaries and the lower reachies of rivers. However frequently they can penetrate far into fresh waters (Muus, 1978).

With the growing interest in marine pollution problems the interest in flounder has considerably increased in recent years as it became a target species in the monitoring of pollution of coastal and estuarine areas, both in respect of tissue levels of chemical residues (Joint Monitoring Group of ICES) and prevalences of pathological conditions (Peters et al.

1987; Vethaak, 1987; Möller, 1990). However, so far, little research has been directed at the biology of the species.

Flounder is one of the few flatfish species, where both right-sided (normal) and left-sided (reversed) individuals can be commonly observed. Some information is summarized on the occurrence of reversed flounder in different areas in the North and Baltic Sea (Table 1). Their prevalences vary from 5.3 % on the UK south coast to 35 % in the Baltic Sea.

During our disease monitoring programme for flounder we have collected information on the frequency of reversed fish, in order to investigate whether the two phenotypes (normal and reversed) differ with respect to pathological characteristics. We also measured enzymatic detoxification activity (EROD=Ethoxyresorufin-0-deethylase) in livers of both right- and left-sided individuals.

This paper summarizes the results and discusses possible implications for disease monitoring programmes.

2. RESULTS

2.1 Frequencies observed in different local stocks and age groups

Table 2 shows the distribution of reversed flounder in Dutch waters. It appears that reversed flounder occur at all sampling localities and that their frequency may vary between approximately 20 and 30 % depending on the habitat. The proportion of reversed flounder appears to be clearly higher in marine habitats than in brackish and fresh water habitats.

Growth curves for both groups in the marine habitat (locality Callantsoog) were determined on the basis of backcalculation of otoliths (Figure 1) (for method see Leeuwen and Vethaak, 1988). Females grow slightly faster than males, but no differences were observed in growth rates between normal and reversed flounder.

From one locality in the Balgzand (Wadden Sea) the frequency by age group has been determined (Table 3) indicating a marked decrease in the relative abundance of left-sided fish with age. This suggests that reversed flounders suffer a significantly higher mortality rate than normal ones.

2.2 Morbidity

Prevalences of Lymphocystis disease and open skin ulcers in the marine environment (locality Callantsoog) have been determined (Table 4). It can be seen that reversed flounders show a trend for higher disease levels than normal ones, at least in intermediate sized males. Due to the small number of fish examined no statistical analysis was attempted on the data and more research is needed to confirm this finding.

2.3 EROD activity

Preliminary results indicate for both sexes a statistically significantly higher hepatic EROD activity in normal fish compared to reversed fish (Table 5) (for methodology see Eggens and Pijnenburg, 1989).

3. DISCUSSION AND CONCLUSION

The differences between the two types of flounder indicate a higher selective mortality and morbidity, and a lower EROD-activity among left-sided specimens. It is well possible that these differences are related to the genetics that determine the directionality of the morphological changes during methamorphosis. The higher selective mortality had already been suggested by Duncer (1896). The higher mortality rate might be related to a lower detoxification capacity for certain organic pollutants and/or to a higher susceptibility to disease of the left-sided phenotype.

On basis of the present findings, it seems important that next to other variables, such as length, age and sex and migration of the fish, also the feature of normal/reversed phenotype should be accounted for in sampling programmes, because the latter ratio might prove a potentially useful index for monitoring environmental deterioration.

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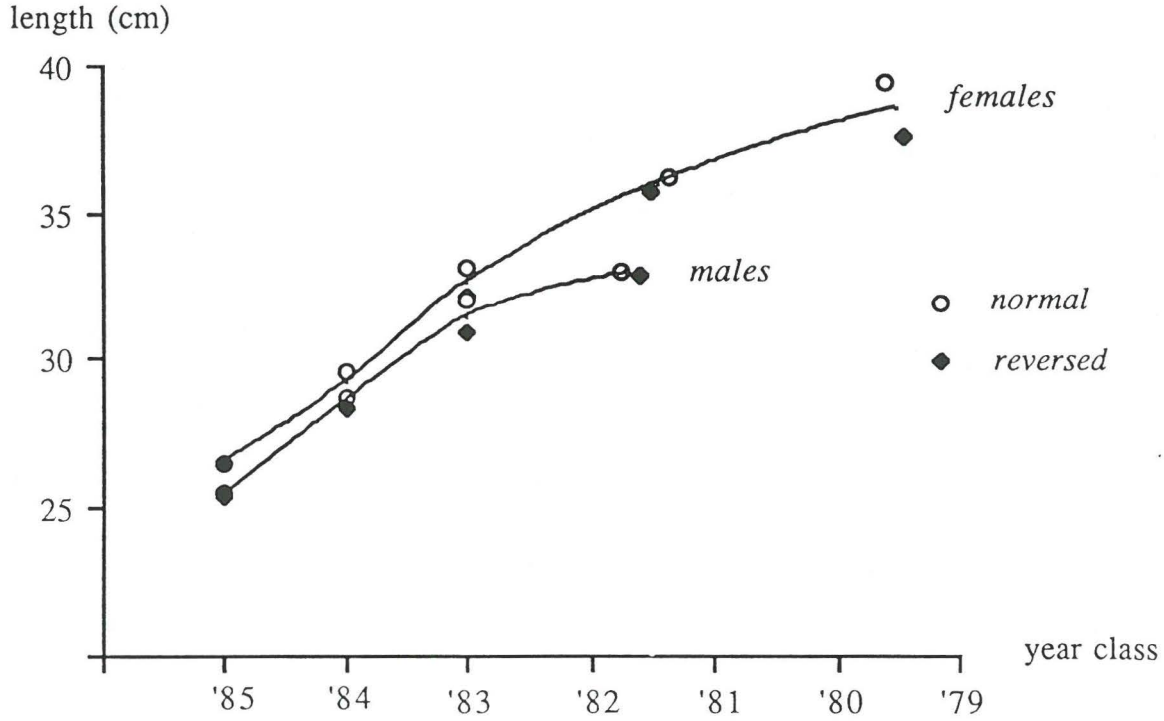

Figure 1: Comparison of growth curves of reversed and normal flounder in Dutch coastal waters (locality Callantsoog).

Table 1: Percentage occurrence of reversed flounder in different areas.

	Percentage reversed	Sample size	Author
Baltic Sea	35.0	3500	Strodtmann, 1906
UK south coast	5.4	1120	Duncer, 1899
UK south coast	5.3	2363	Hartley, 1940
Dutch North Sea area	31.3	198	Roest, 1972
Irish Sea	0	76	Roest, 1972

Table 2: Percentage occurrence of reversed flounder in Dutch waters in August -September 1987-89.

	Percentage reversed	Sample size
MARINE HABITAT		
-Dutch coastal waters		
mouth Wester Scheldt	28.0	143
mouth Eastern Scheldt	28.7	1271
mouth Haringvliet	26.8	235
vicinity of Rhine	26.1	1744
vicinity of North Sea canal	29.5	440
locality Callantsoog	29.0	2854
-Wadden Sea (Ameland)	28.1	290
-Belgian coastal waters	28.5	242
BRACKISH HABITAT		
-Western Scheldt estuary	24.7	2242
-Lake Grevelingen	24.7	409
-Ems Dollard estuary	22.3	578
FRESH WATER HABITAT		
-Haringvliet	26.5	102
-Lake IJssel	23.0	496
-Lake Lauwersoog	21.5	130

Table 3: Percentage occurrence of reversed flounder in different age groups. Samples derived from a survey carried out in July/August 1990 in the Dutch Wadden Sea (locality Balgzand).

Age group	Percentage reversed	Sample size
0	42.6	528
1	37.0	1290
>1	21.3	1433

Table 4: Prevalence of some epidermal diseases in normal and reversed flounder. Samples derived from a survey carried out in August 1987 in Dutch coastal waters (locality Callantsoog).

	NORMAL			REVERSED		
	length group			length group		
	20-24 cm	25-29 cm	> 29 cm	20-24 cm	25-29 cm	> 29 cm
Male						
No of fish examined	164	140	16	55	56	9
Lymphocystis disease	22.0	38.6	43.8	25.5	50.0	44.4
Open skin ulcers	3.0	2.1	0	5.5	7.1	11.1
Female						
No of fish examined	129	143	164	45	54	57
Lymphocystis disease	13.2	21.7	26.2	15.6	24.1	26.3
Open skin ulcers	5.4	8.4	3.7	8.9	7.4	3.5

Table 5: EROD activity (nMol resorufin/mg protein) in normal and reversed flounder. Samples derived from a survey carried out in August 1988 in the Dutch coastal waters (locality Callantsoog).

	NORMAL/ REVERSED	SAMPLE SIZE	MEAN	STAND. ERR. OF THE MEAN	
SEX					
female	N	58	0.63	0.02	
female	R	8	0.32	0.11	$p<0.025$
male	N	52	0.67	0.02	
male	R	19	0.48	0.07	$p<0.011$