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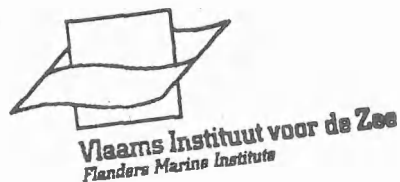
Mercury concentrations in plaice, flounder and dab from Belgian continental shelf waters (1971-1990)

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Summary

Results obtained during a survey of 20 years on plaice (*Pleuronectes platessa*) and 15 years on flounder (*Platichthys flesus*) and dab (*Limanda limanda*) are reported.

With flounder, two periods could be distinguished. In 1975-1981, higher mercury concentrations (0.38 mg/kg on average) with rather large variations were noted. From 1982 on, concentrations fluctuated around the same mean value (0.23 mg/kg).

A gradual decrease of mercury levels in plaice was observed during the twenty years' monitoring period. The mean concentration in 1990 (0.06 mg/kg) was only one third of that of 1971 (0.18 mg/kg). In contrast with flounder and plaice, mercury concentrations in dab remained practically at the same level (0.09-0.13 mg/kg).

1. Introduction

The mercury concentration in fishery products has been a cause of concern from the late sixties on, especially since the outbreaks of mercury poisoning in Japan were found to originate from the consumption of heavily contaminated fish.

Large-scale surveys were started in many countries. In Belgium, monitoring mercury levels in representative fish and shellfish species began in 1971.

Flatfish species are well suited for monitoring trace contaminants in the marine environment due to the fact that they live near or in the sea bed and that many populations are quite sedentary.

This paper reports results obtained during a survey of 20 years on plaice (*Pleuronectes platessa*) and 15 years on flounder (*Platichthys flesus*) and dab (*Limanda limanda*) from Belgian continental shelf waters. Results up to 1985 have already been published (De Clerck et al., 1974, 1979, 1984, 1988; Vyncke et al., 1981; Misra et al., 1989).

The annual monitoring programme on flatfish started with plaice in 1971 and was carried out until 1978, when flounder was preferred as an indicator species, according to recommendations by ICES (1978). Plaice however was further monitored in 1985 and 1990, in the framework of the ICES baseline studies. Within the same programmes, dab was analyzed in 1975-77, 1985 and 1990.

2. Methods and materials

2.1. Fish samples

Plaice, flounder and dab were caught in Belgian continental shelf waters, prior to spawning. The length of the fish varied between 15 and 35 cm for plaice, 20 and 50 cm for flounder and 20 and 30 cm for dab. Whenever possible an equal number of males and females was taken.

The number of specimens during this long survey period varied according to the availability of the fish and the revised recommendations by ICES (1978, 1979, 1990). The number of samples is indicated in figures 1 to 3.

All fish were analyzed individually, except plaice and dab in 1990, where bulked samples of 25 fish were used.

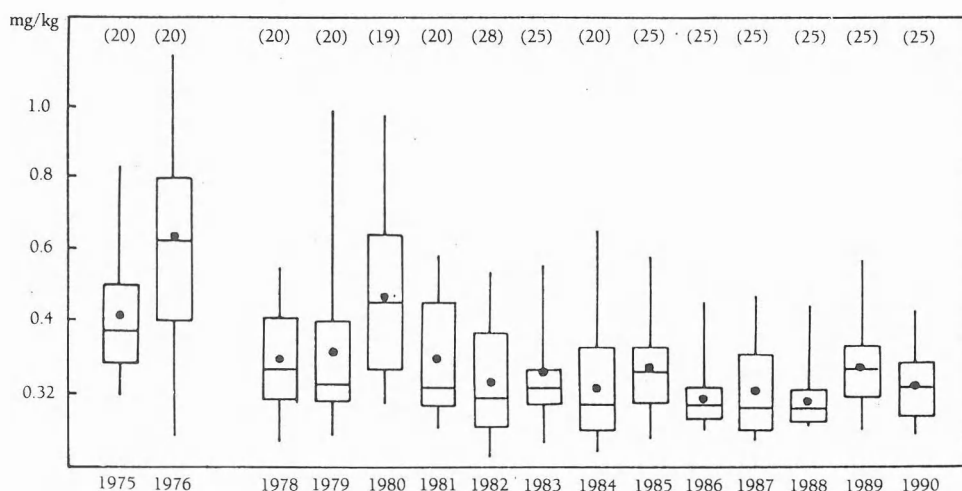
2.2. Mercury analysis

After destruction of the fish muscle with sulphuric acid and hydrogen peroxide, mercury is determined with a Coleman MAS-50 mercury analyzer (Coleman Instruments, Maywood, Ill., USA) (De Clerck et al., 1974). The method remained unchanged over the whole monitoring period, allowing a good intercomparison of the data.

2.3. Statistics

A visual assessment of the results was obtained from box-and-whisker plots (Tukey, 1977). These plots show the upper and

Figure 1 Mercury concentrations in flounder (quartiles) (a)



(a) Number of samples in brackets; black dot : average value

Table 1 Comparison of mercury concentrations in flounder in the periods 1975-1981 and 1982-1990 (mg/kg)

	1975-1981	1982-1990
n	119	223
max.	1.15	0.84
0.75 fractile	0.50	0.31
median	0.32	0.20
0.25 fractile	0.21	0.13
min.	0.07	0.03
average	0.38	0.23
s	0.24	0.13

lower quartiles (0.75 and 0.25 fractiles) at the top and bottom of a 'box' with a parallel intermediate line corresponding to the median. A 'whisker' or vertical line is then drawn from the upper quartile to the maximum and from the lower quartile to the minimum.

3. Results and discussion

Evaluation of the box-and-whisker plot for flounder (figure 1) shows that two periods can be distinguished. In the period 1975 to 1981, higher mercury concentrations with rather large variations were noted. From 1982 on, concentrations fluctuated around the same mean values.

It should be noticed however that statistical analysis using mercury levels adjusted for length differences between years showed evidence of a downward trend in the period 1983-1988. This trend analysis was carried out in the framework of the 'Joint monitoring programme' of the Oslo and Paris Commissions (Anon., 1990). In 1989, however, this downward trend was apparently stopped.

In the same period (1983-1988) no clear trends were found for flounder from the Dutch coast, the Wadden Sea and the Ems-Dollard estuary. In the inner German Bight and in the Oslo-Fjord however an upward tendency was noted indicating that trends in

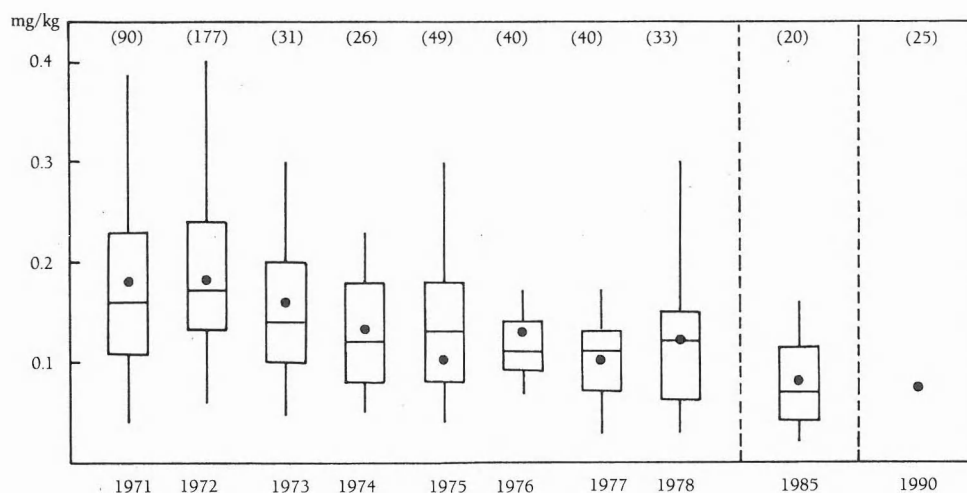
mercury concentrations are area dependent (Anon., 1990).

Table 1 summarizes the differences between the periods 1975-1981 and 1982-1990. In the latter period, mercury levels were on an average 40 % lower than in 1975-1981. The standard deviations were significantly different ($p = 99.9$ %) stressing larger variations in 1975-1981.

The Paris Commission (1985) has established an 'Environmental quality standard' for mercury in fish flesh of 0.3 mg/kg wet weight. This standard was exceeded on average in 25.2 % of the samples in 1982-1990 against 56.3 % in 1975-1981, showing again the lower mercury concentrations in recent years.

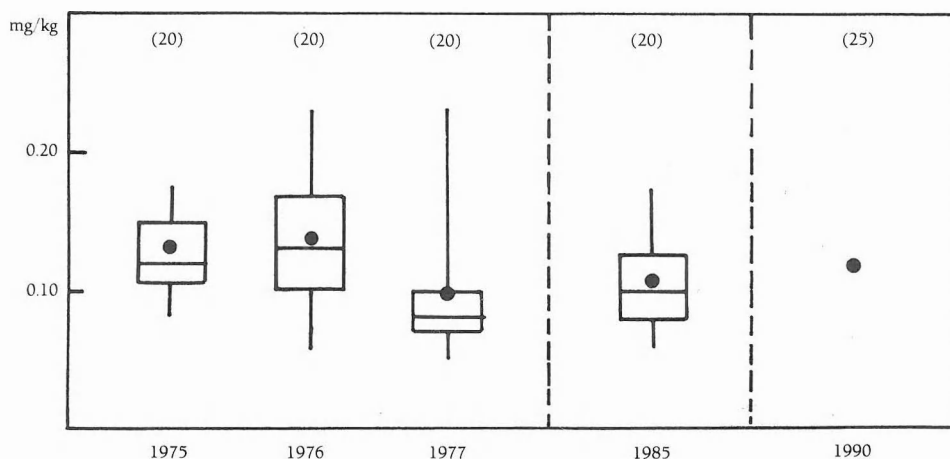
A gradual decrease of mercury levels in plaice was observed during the 20 years'

Figure 2 Mercury concentrations in plaice (quartiles) (a)



(a) number of samples in brackets; black dot : average value

Figure 3 Mercury concentrations in dab (quartiles) (a)



(a) number of samples in brackets; black dot : average value

Table 2 Average mercury levels in flatfish
(a)

	1971	1975	1990
Flounder	—	***	**
Plaice	**	**	*
Dab	—	*	*

(a) * : lower level (< 0.1 mg/kg)

** : medium level (0.1-0.3 mg/kg)

*** : upper level (> 0.3 mg/kg)

monitoring period (figure 2).

The average concentration in 1990 (0.06 mg/kg) was only one third of that of 1971

(0.18 mg/kg).

In 1971 and 1972 an average of 10 % of the plaice exceeded the environmental standard of 0.3 mg/kg. Since 1973 this has not been found again.

A downward trend was also noted by other investigators along the English and Danish coasts. On the other hand, no clear evolution was observed in the inner German Bight and the Skagerrak (Anon., 1990).

In contrast with flounder and plaice, mercury concentrations in dab remained prac-

tically at the same level (figure 3). Average values fluctuated in a narrow range (0.09-0.13 mg/kg). The environmental standard of 0.3 mg/kg was never exceeded. The three Pleuronectidae showed different accumulation patterns for mercury. Concentrations in flounder were markedly higher than in plaice and dab, an observation already made in international monitoring programmes from 1977 on (ICES, 1980, 1984, 1988).

The Paris Commission (1984) has adopted the following arbitrary division of mercury concentrations ranges for fish flesh : lower level : < 0.1, medium level : 0.1-0.3 and upper level > 0.3 mg/kg wet weight. Table 2 shows the application of these guidelines for the monitoring periods under consideration. Recent data (1990) indicate mercury levels to be in the lower or medium range at the present time.

Conclusions

While mercury levels in dab remained more or less constant, flounder and plaice showed a downward trend in Belgian continental shelf waters over a period of 15 and 20 years respectively. This would give evidence for the effectiveness of measures for the reduction of mercury pollution taken in the framework of the conventions for the protection of the marine environment and the EEC.

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References

ANON. 1990. Assessment of data submitted for temporal trend analysis : mercury in fish (muscle tissue). Paper 12/8/3, Twelfth Joint Meeting of the Oslo and Paris Commissions.

DE CLERCK, R., VANDERSTAPPEN, R. and VYNCKE, W. 1974. Mercury content of fish and shrimps caught off the Belgian coast. *Ocean Management*, **2**, 117-126.

DE CLERCK, R., VANDERSTAPPEN, R., VYNCKE, W. et VAN HOEYWEGHEN, P. 1979. La teneur en métaux lourds dans les organismes marins provenant de la capture accessoire de la pêche côtière belge. *Revue de l'Agriculture*, **32**, 793-801.

DE CLERCK, R., GUNS, M., VYNCKE, W. et VAN HOEYWEGHEN, P. 1984. La teneur en métaux lourds dans le cabillaud, le flet et la crevette des eaux côtières belges. *Revue de l'Agriculture*, **37**, 1079-1086.

DE CLERCK, R., GUNS, M., VYNCKE, W. et VAN HOEYWEGHEN, P. 1988. Métaux lourds dans les organismes marins de la mer d'Irlande. *Revue de l'Agriculture*, **41**, 213-220.

ICES 1978. Report of the International Council for the Exploration of the Sea to the Oslo Commission, the Interim Helsinki Commission and the Interim Paris Commission, 1977. Cooperative Research Report No. 76. International Council for the Exploration of the Sea, Copenhagen.

ICES 1979. Report of the ICES Advisory Committee on Marine Pollution, 1978. Cooperative Research Report No. 84. International Council for the Exploration of the Sea, Copenhagen.

ICES 1980. The ICES Coordinated Monitoring Programme, 1977. Cooperative Research Report No. 98. International Council for the Exploration of the Sea, Copenhagen.

ICES 1984. The ICES Coordinated Monitoring Programme for contaminants in fish and shellfish, 1978 and 1979, and six year review of ICES coordinated monitoring programme. Cooperative Research Report No. 126. International Council for the Exploration of the Sea, Copenhagen.

- ICES 1988. Results of 1985 baseline study of contaminants in fish and shellfish. Cooperative Research Report No. 151. International Council for the Exploration of the Sea, Copenhagen.
- ICES 1989. Report of the ICES Advisory Committee on Marine Pollution, 1989. Cooperative Research Report No. 167. International Council for the Exploration of the Sea, Copenhagen.
- ICES 1990. Report of the ICES Advisory Committee on Marine Pollution, 1990. Cooperative Research Report No. 172. International Council for the Exploration of the Sea, Copenhagen.
- MISRA, R., UTHE, J. and VYNCKE, W. 1989. Monitoring of time trends in contaminant levels using a multispecies approach : Contaminant trends in Atlantic cod (*Gadus morhua*) and European flounder (*Platichthys flesus*) on the Belgian coast, 1978-1985. Marine Pollution Bulletin, **20**, 500-502.
- Paris Commission 1984. Fourth and Fifth annual reports on the activities of the Paris Commission, London.
- Paris Commission 1985. First and Second annual reports on the activities of the Paris Commission, London.
- TUKEY, J. 1977. Exploratory data analysis. Addison-Wesley Publ. Co. Reading, Mass. USA.
- VYNCKE, W., VANDERSTAPPEN, R., DE CLERCK, R., MOERMANS, R. et VAN HOEYWEGHEN, P. 1981. L'évolution de la teneur en métaux lourds dans la plie, le merlan, le sprat et les crevettes pêchées dans les eaux côtières belges. Revue de l'Agriculture, **34**, 1351-1365.

Samenvatting

Kwikgehalten in schol, bot en schar van het Belgisch continentaal plat (1971-1990)

Resultaten bekomen gedurende een onderzoek van 20 jaar op schol (*Pleuronectes platessa*) en 15 jaar op bot (*Platichthys flesus*) en schar (*Limanda limanda*) worden gerapporteerd.

Voor bot konden twee perioden worden onderscheiden. In 1975-1981 werden hogere kwikgehalten (gemiddeld 0,38 mg/kg) met relatief grote variaties genoteerd. Vanaf 1982 fluctueerden de concentraties rond dezelfde

gemiddelde waarde (0,23 mg/kg).

In schol werd een geleidelijke daling van de kwikgehalten gedurende de monitoring-periode van 20 jaar vastgesteld. De gemiddelde concentratie in 1990 (0,06 mg/kg) bedroeg slechts één derde van deze van 1971 (0,18 mg/kg).

In tegenstelling tot bot en schol bleven de kwikgehalten in schar praktisch op hetzelfde peil (0,09-0,13 mg/kg).

Résumé

Les concentrations de mercure dans la plie, le flet et la limande du plateau continental belge (1971-1990)

Les résultats obtenus pendant une période d'investigation de 20 ans sur la plie (*Pleuronectes platessa*) et de 15 ans sur le flet (*Platichthys flesus*) et la limande (*Limanda limanda*) sont rapportés.

Avec le flet, deux périodes peuvent être discernées. En 1975-1984, des concentrations de mercure (0,38 mg/kg en moyenne) plus élevées, avec des variations assez importantes furent notées. A partir de 1982, les taux fluctuèrent autour de la même valeur moyenne

(0,23 mg/kg).

Dans la plie, une baisse graduelle des concentrations de mercure fut observée pendant la période d'investigation de 20 ans. Le taux moyen en 1990 (0,06 mg/kg) n'atteint qu'un tiers de celui de 1971 (0,18 mg/kg).

Contrairement aux observations dans le flet et la plie, les concentrations de mercure dans la limande demeurèrent pratiquement au même niveau (0,09-0,13 mg/kg).