Baltic Marine Environment Protection Commission

Expert Group on Monitoring of Radioactive Substances in the Baltic Sea

MORS EG 5-2015

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Code	4-4
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Submitted by	Data Coordinator
Reference	

Background

This document contains the basic graphs for verification of the MORS environmental data of 1984-2013, compiled by the HELCOM Secretariat Data Administrator.

Action required

The Meeting is invited to take note, consider and comment on the information.

CALCULATION PRINCIPLES OF THE ENVIRONMENTAL DATA

BIOTA

Concentrations of ^{137}Cs and ^{90}Sr in fish muscle have been reported on herring (*Clupea harengus*). Concentrations of ^{137}Cs has been reported on cod (*Gadus morhua*), and plaice (*Pleuronectes platessa*) and flounder (*Platichthys flesus*) data of 1984-2013 as wet weight values of fish muscle. Reported dry weight concentrations have been converted to wet weight values. As a result average concentrations and uncertainties have been calculated for each species (plaice and flounder together), for both nuclides and by basin and year.

Two different tissue types for herring muscle have been reported separately. Concentrations in herring have been analyzed for fillets (flesh without bones) and whole fish (without head and entrails). Concentrations in cod and flounder and plaice muscle have been reported only on fillets. Plaice and flounder have been considered as one species in the results.

Concentrations of ^{137}Cs in bladder wrack (Fucus vesiculosus), have been calculated based on dry weight concentrations. Wet weight concentrations have been converted to dry weight values when reported. Average concentrations have been calculated by basin and by year.

All values below the limit of detection (LOD) have been omitted from the calculations. Uncertainty has been calculated and added in the graphs as error bars. Any missing values of uncertainties have been replaced with value 10 and used for uncertainty calculations.

SEAWATER

For seawater ^{137}Cs and ^{90}Sr concentrations of 1984-2013 have been reported for surface and bottom waters. For ^{239,240}Pu, there was no new data reported for the year 2013 in surwace or bottom water.

The following depth criteria have been used:

For surface water the sampling depth ≤ 10 m

The average concentrations of nuclides in surface water have been calculated by year and by MORS sub-basin division used in MORS Guidelines and current database reporting.

For bottom water

1) Sampling depth > 100 m; or

2) 10m < sampling depth ≤ 100 m and the difference between the total depth and sampling depth ≤ 10 m. The average concentrations of nuclides have been calculated by year and by basin.

All values below the limit of detection (LOD) have been omitted from the calculations. If LOD values have been reported in certain year and basin, the years have been indicated in the figures. Similar calculation method of mean and uncertainty as for biota has been used.

SEDIMENT

Concentrations of two nuclides ^{40}K and ^{137}Cs have been analyzed of the reported sediment data of 1984-2013. Average concentrations in Bq/m2 (^{137}Cs, ^{40}K) have been calculated for the following stations:

CVI	65º14,16'N, 23º33,60'E in the Bothnian Bay
EB1	61º04,00'N, 19º44,00'E in the Bothnian Sea
LL3a	60º04,40'N, 26º20,50'E in the Gulf of Finland
TEILI1	59º26,00'N, 21º29,80'E in the Northern Baltic Proper (prior year 2004)
LL17	59°02,00'N, 21°04,48 E in the Northern Baltic Proper (after year 2004)
BY15	57º19,20'N, 20º03,00'E in the Baltic Proper
P5	55º15,00'N, 15º59,00'E in the Bornholm Sea
P1	54º50,00'N, 19º20,00'E in the Southern Baltic Proper
FBELT1	54º36,00'N, 11º13,00'E in the Belt Sea

Only surface sediment (0-10 cm) concentrations has been used for figures.

All values below the limit of detection (LOD) have been omitted from the calculations. Reported LOD values have been indicated as asterisks in the graphs. No uncertainty has been reported on sediment data due to the very high variation between the samples (sliced sediment).

DATABASE

The updated database will be made available in HELCOM website (http://www.helcom.fi/baltic-sea-trends/data-maps/sea-environmental-status/radionuclide-concentrations/) for the contracting parties and the public after the verification. The used data format is MS Access database (accdb). The graphs will be also made available using interactive Excel web services.

The revision of HELCOM subbasin divisions is indicated in the database tables BIO01, SEA01 and SED01 by in HELCOM_SUBBASIN column and a new table HELCOM_SUBBASIN.

THE LIST OF GRAPHS THE MORS ENVIRONMENTAL DATA 1984-2013

BIOTA

HERRING

Figures 1a-d. ^{137}Cs (Bq/kg of wet weight) in herring muscle (without head and entrails) 1984-2013

Figures 2a-h. ^{137}Cs (Bq/kg of wet weight) in herring muscle (fillets) 1984-2013

Figures 3a-d. ^{90}Sr (Bq/kg of wet weight) in herring muscle (without head and entrails) 1984-2013

PLAICE AND FLOUNDER

Figures 4a-e. ^{137}Cs (Bq/kg of wet weight) in plaice and flounder 1984-2013

COD

Figures 5a-e. ^{137}Cs (Bq/kg of wet weight) in cod muscle (fillets) 1984-2013

BLADDER WRACK (FUCUS VESICULOSUS)

Figures 6a-g. ^{137}Cs (Bq/kg of dry weight) in *Fucus vesiculosus* 1984-2013

SEAWATER

SURFACE

Figures 7a-m. ^{137}Cs (Bq/m^3) in surface water 1984-2013

Figures 8a-m. ^{90}Sr (Bq/m^3) in surface water 1984-2013

BOTTOM

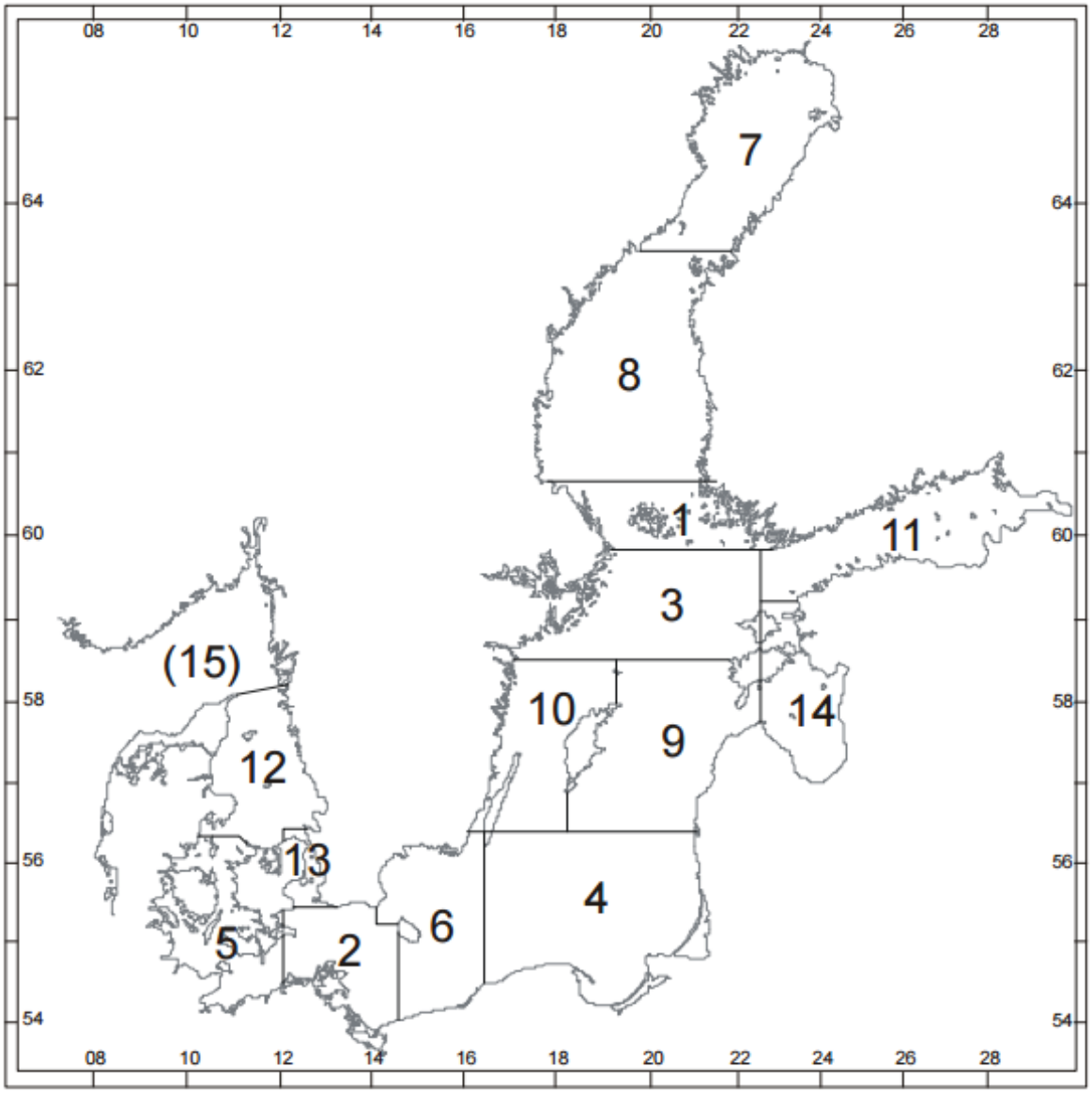
Figures 9a-m. ^{137}Cs (Bq/m^3) in bottom water 1984-2013

Figures 10a-h. ^{90}Sr (Bq/m^3) in bottom water 1984-2013

SEDIMENT

Figures 11a-h. ^{137}Cs (Bq/m^2) in surface sediment (0-10 cm) at 9 stations surface 1984-2013

The use of subdivisioning in the graphs is following HELCOM MORS subbasins due to continuity and comparability of time series compared to previous environmental data reports.



Division of the Baltic Sea into Sub-basins

1. Archipelago Sea
2. Arkona Sea
3. Northern Baltic Proper
4. Southern Baltic Proper
5. Belt Sea
6. Bornholm Sea
7. Bothnian Bay
8. Bothnian Sea
9. Gotland East
10. Gotland West
11. Gulf of Finland
12. Kattegat
13. Sound
14. Gulf of Riga

(15.Skagerak)

FIGURES

BIOTA: HERRING Figures 1a-d. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin.

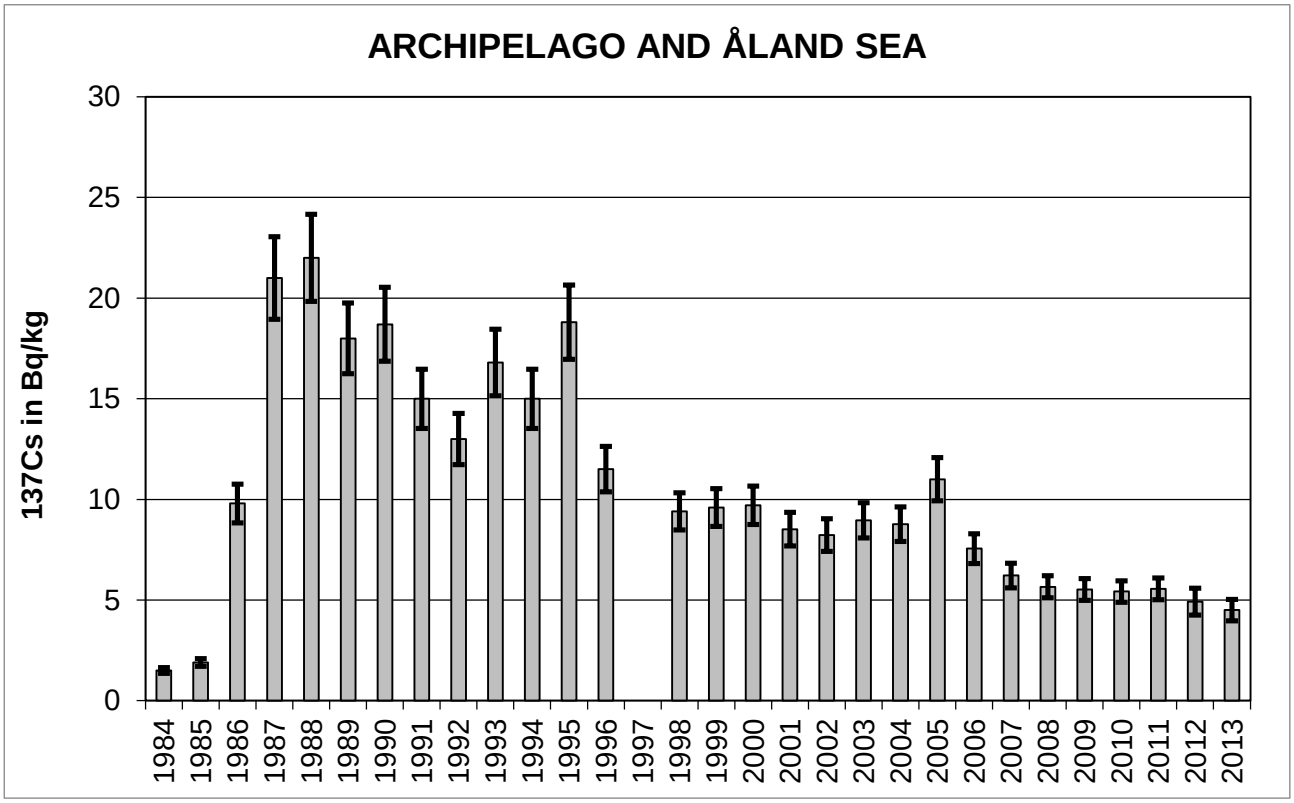


Figure 1a. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**ARCHIPELAGO AND ÅLAND SEA**).

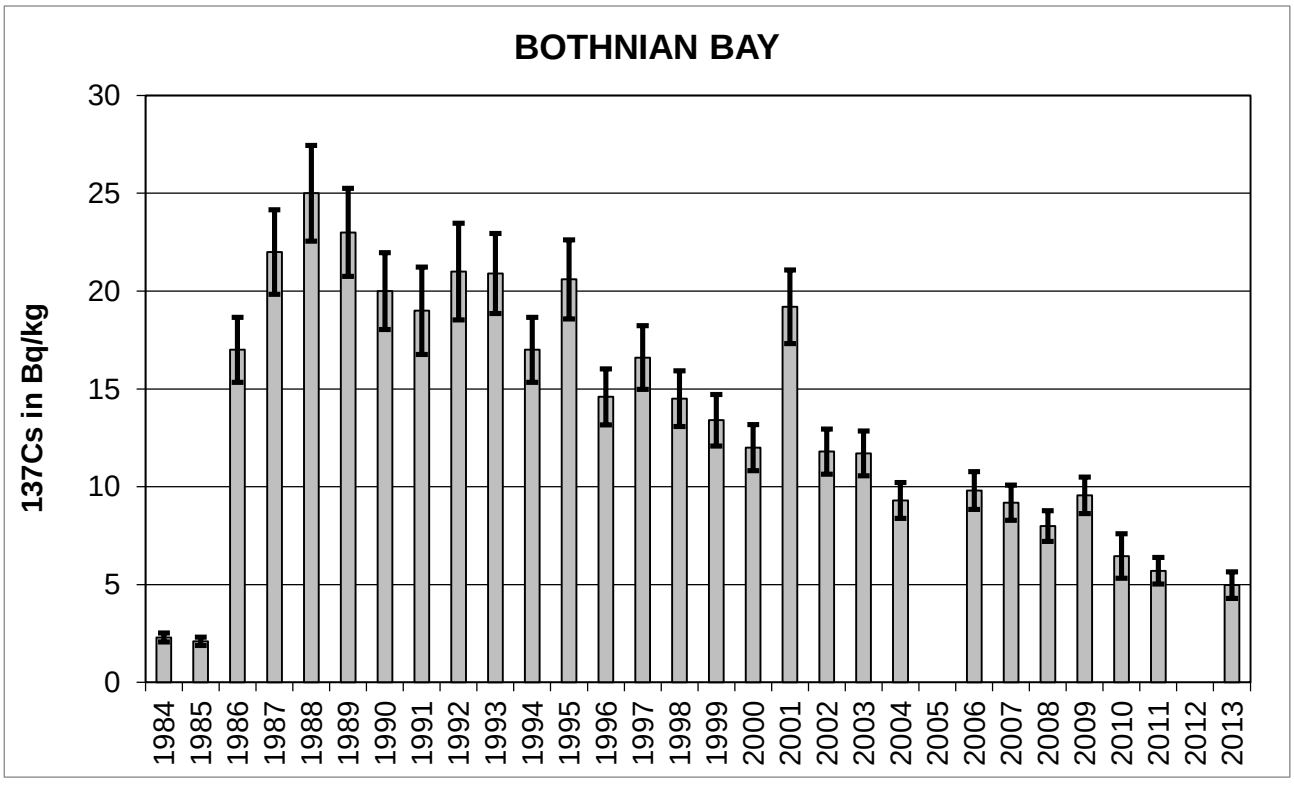


Figure 1b. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**BOTHNIAN BAY**).

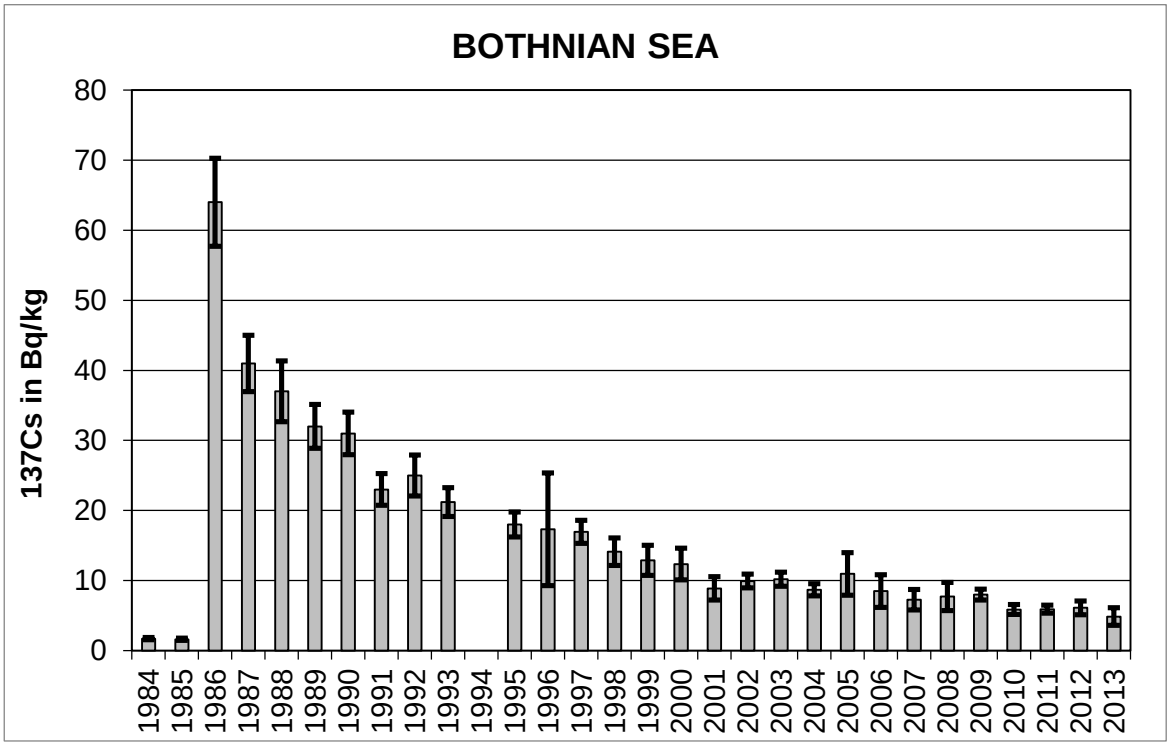


Figure 1c. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**BOTHNIAN SEA**).

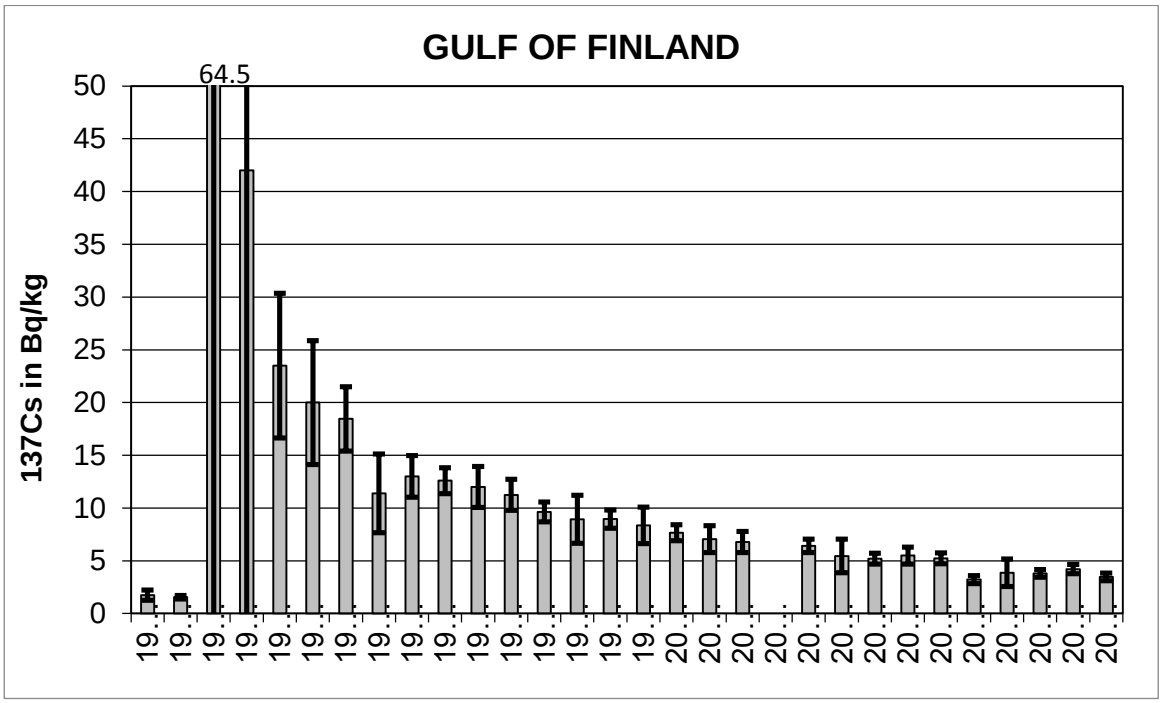


Figure 1c. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**GULF OF FINLAND**).

BIOTA: HERRING Figures 2a-h. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin.

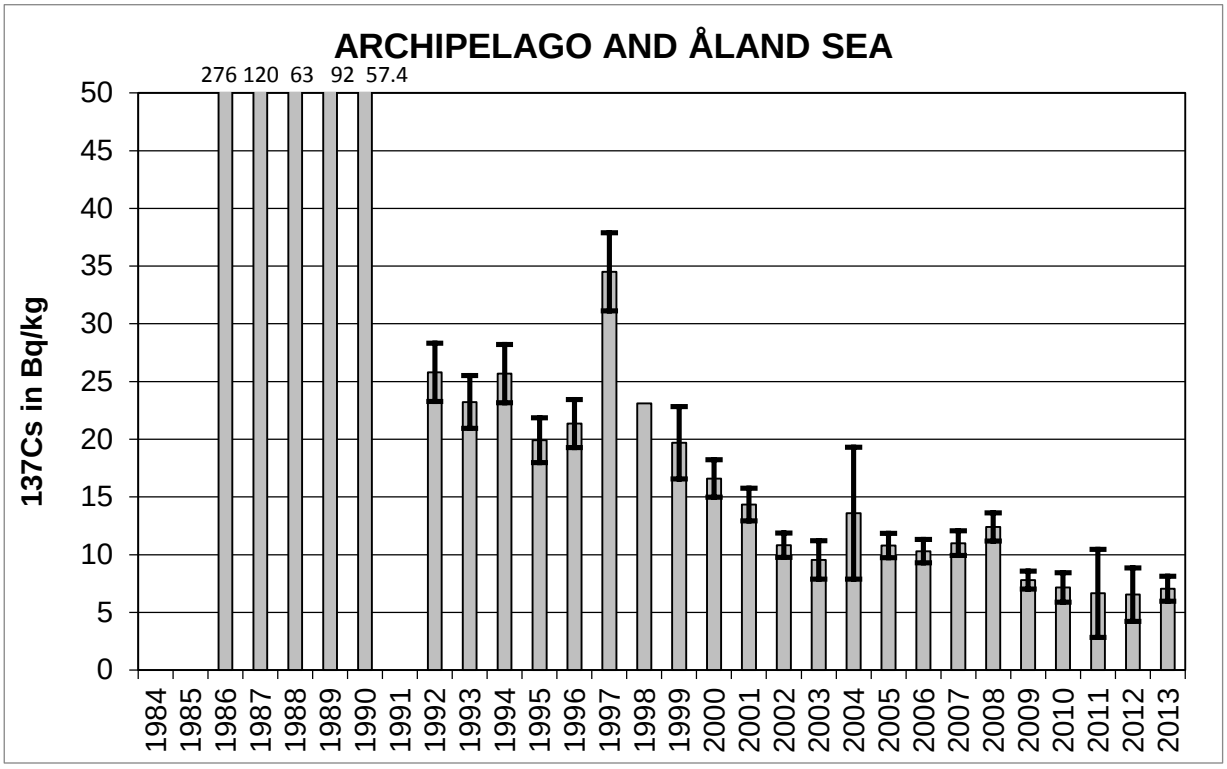


Figure 2a. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**ARCHIPELAGO AND ÅLAND SEA**).

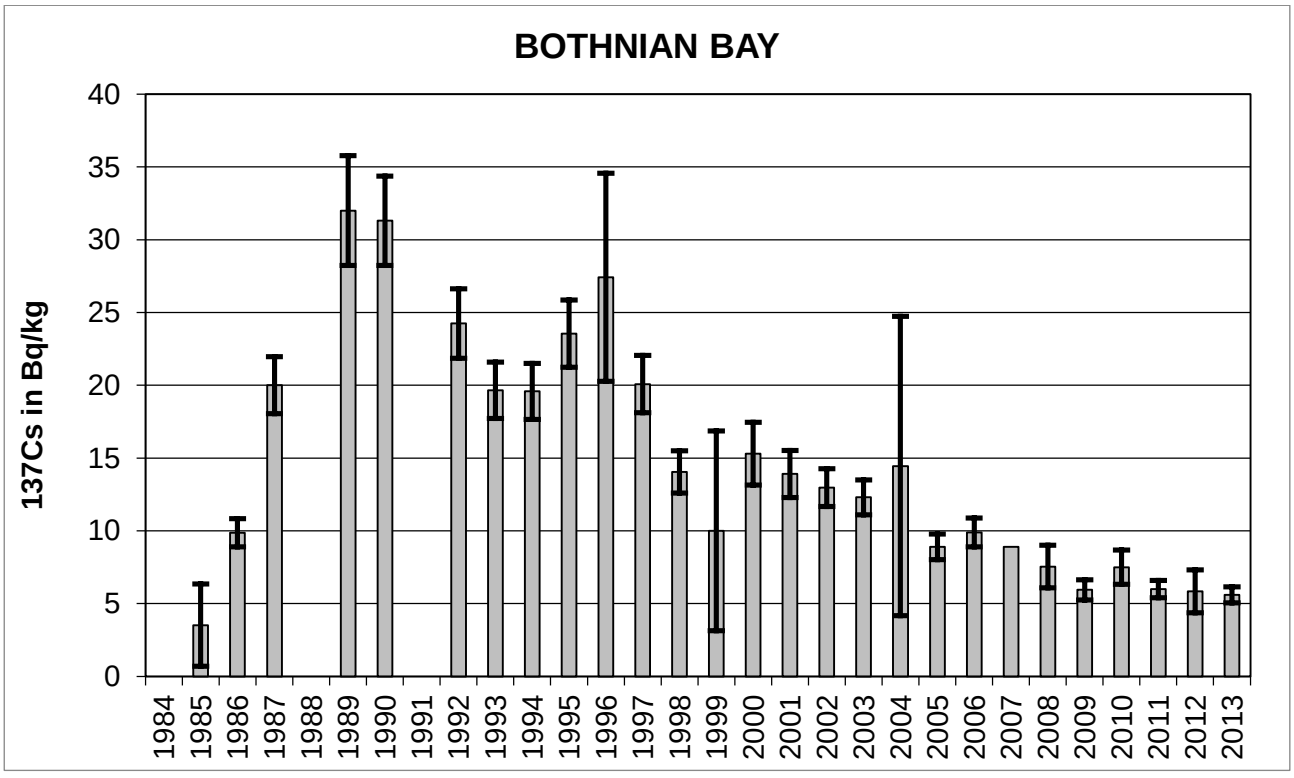


Figure 2b. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**BOTHNIAN BAY**).

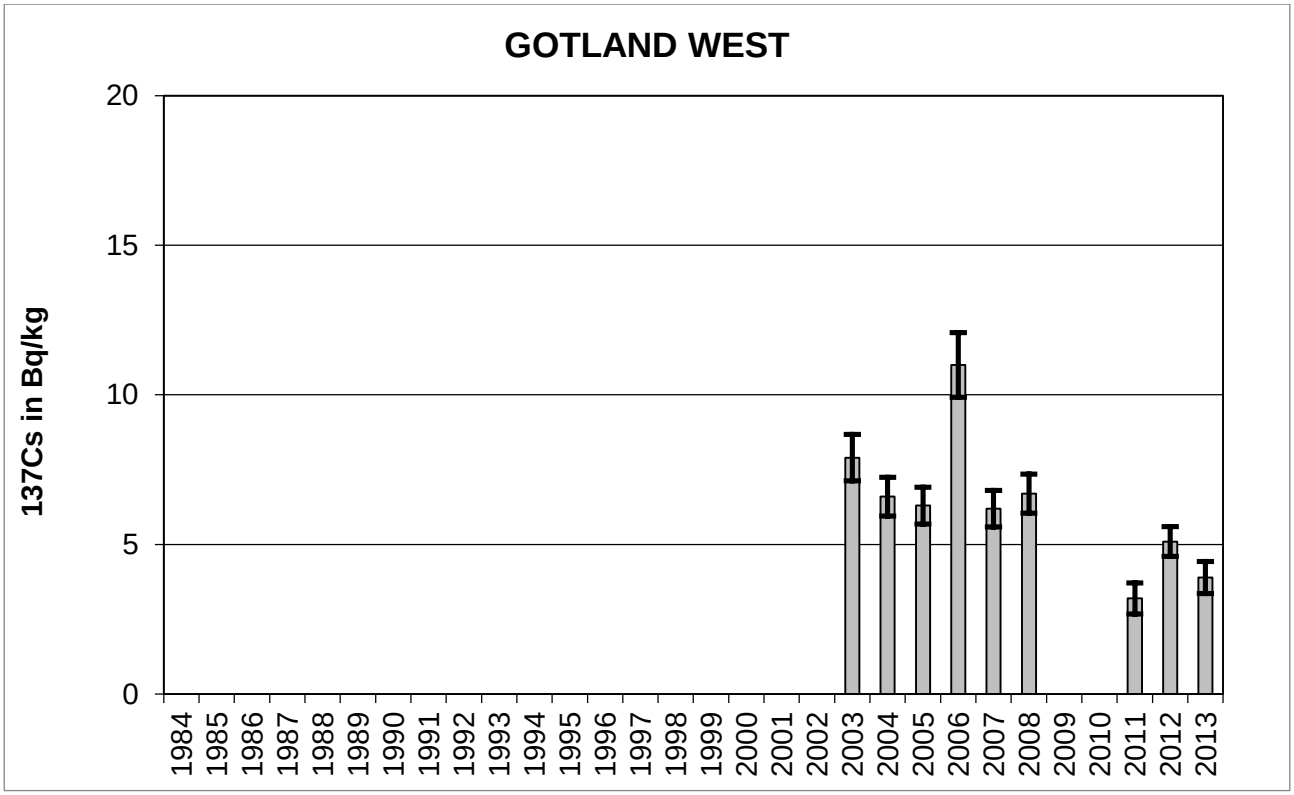


Figure 2c. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**GOTLAND WEST**).

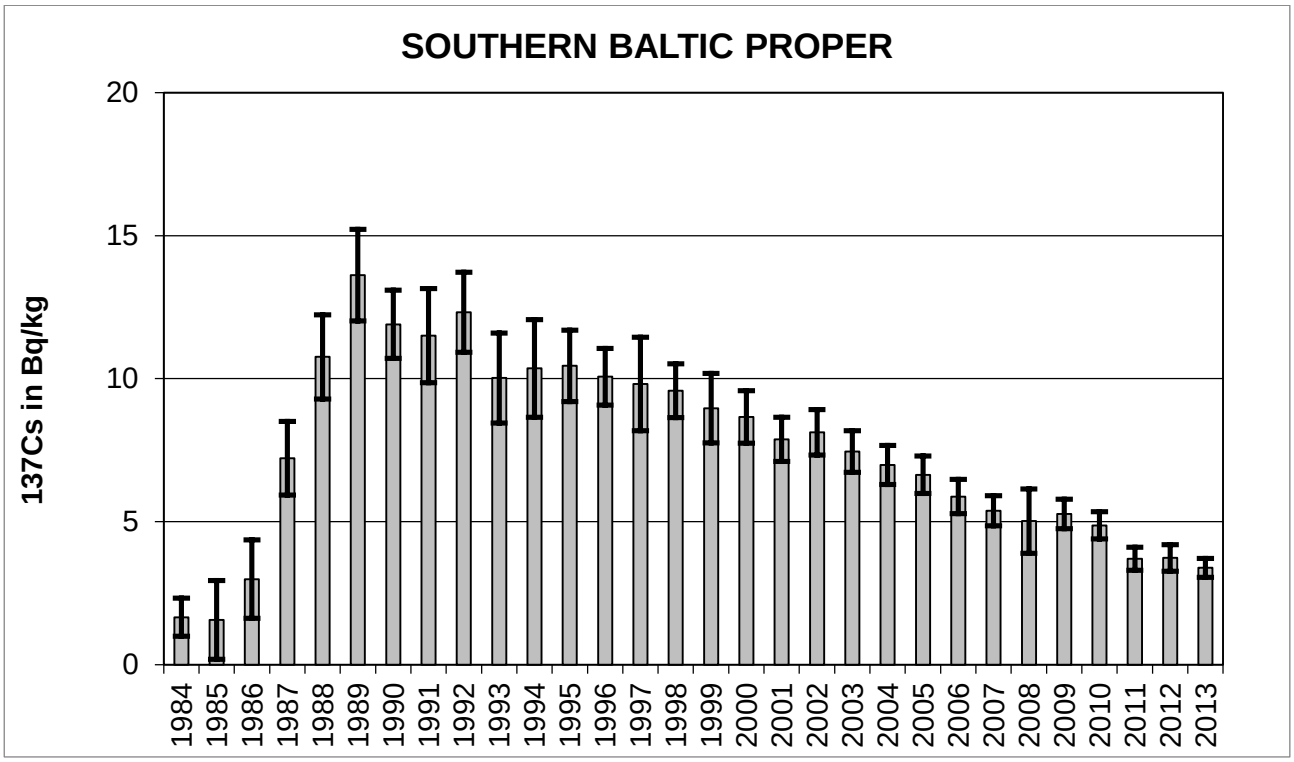


Figure 2d. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**SOUTHERN BALTIC PROPER**).

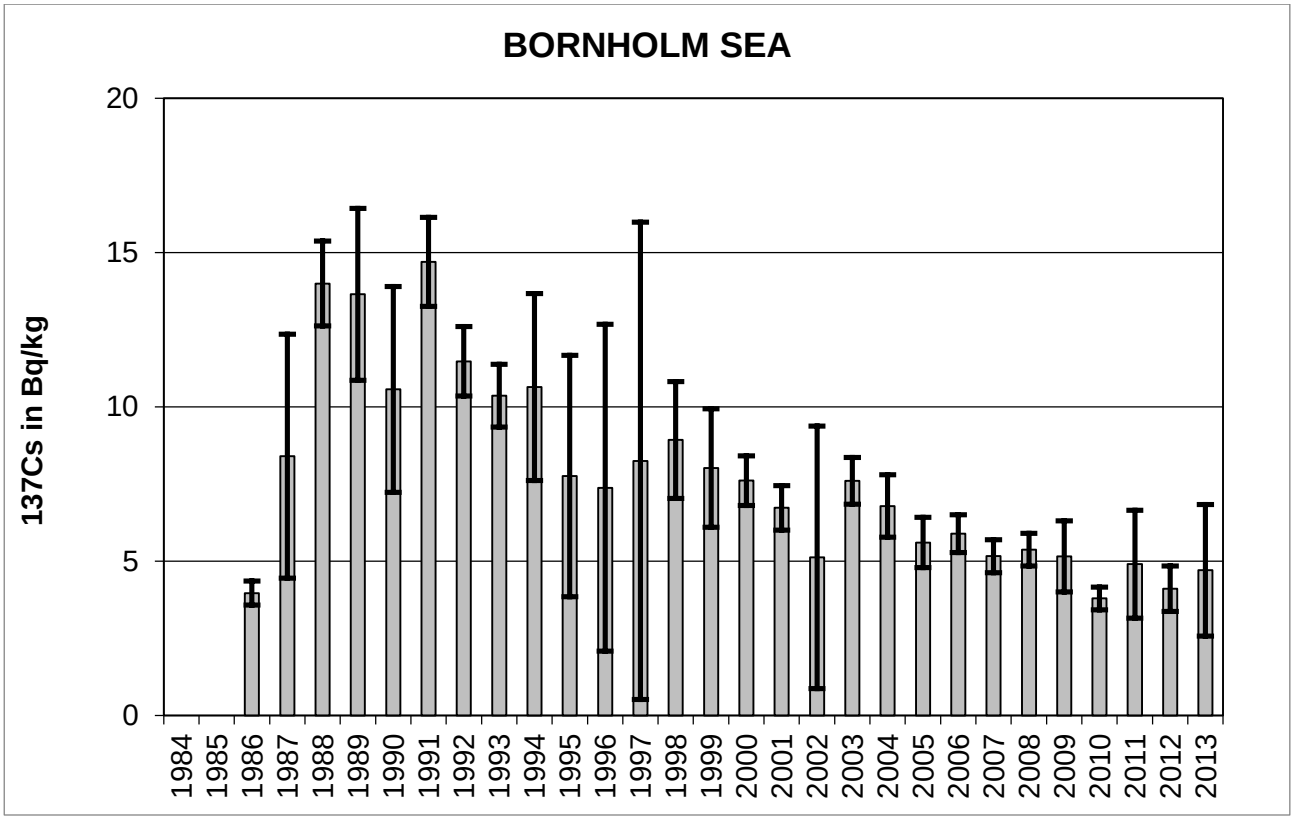


Figure 2e ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**BORNHOLM SEA**).

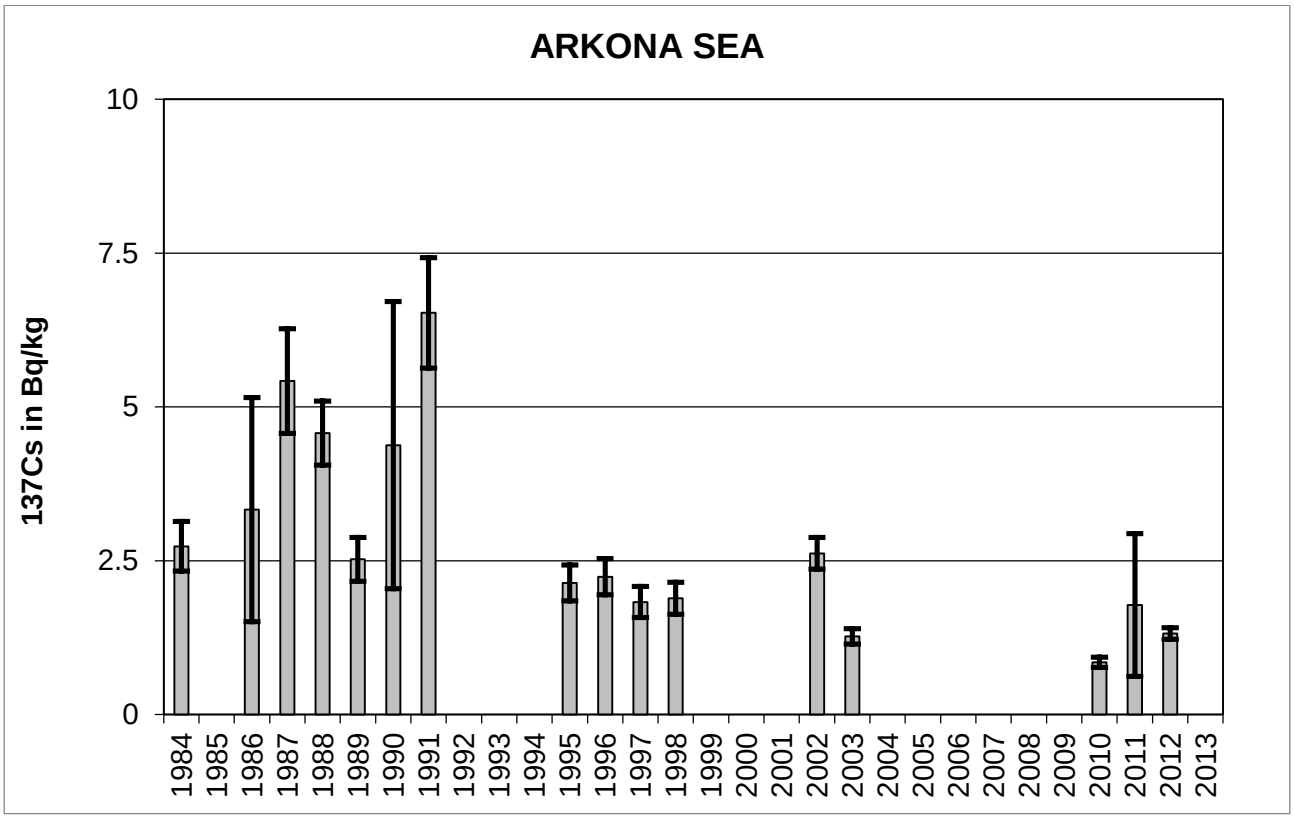


Figure 2f. ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**ARKONA SEA**).

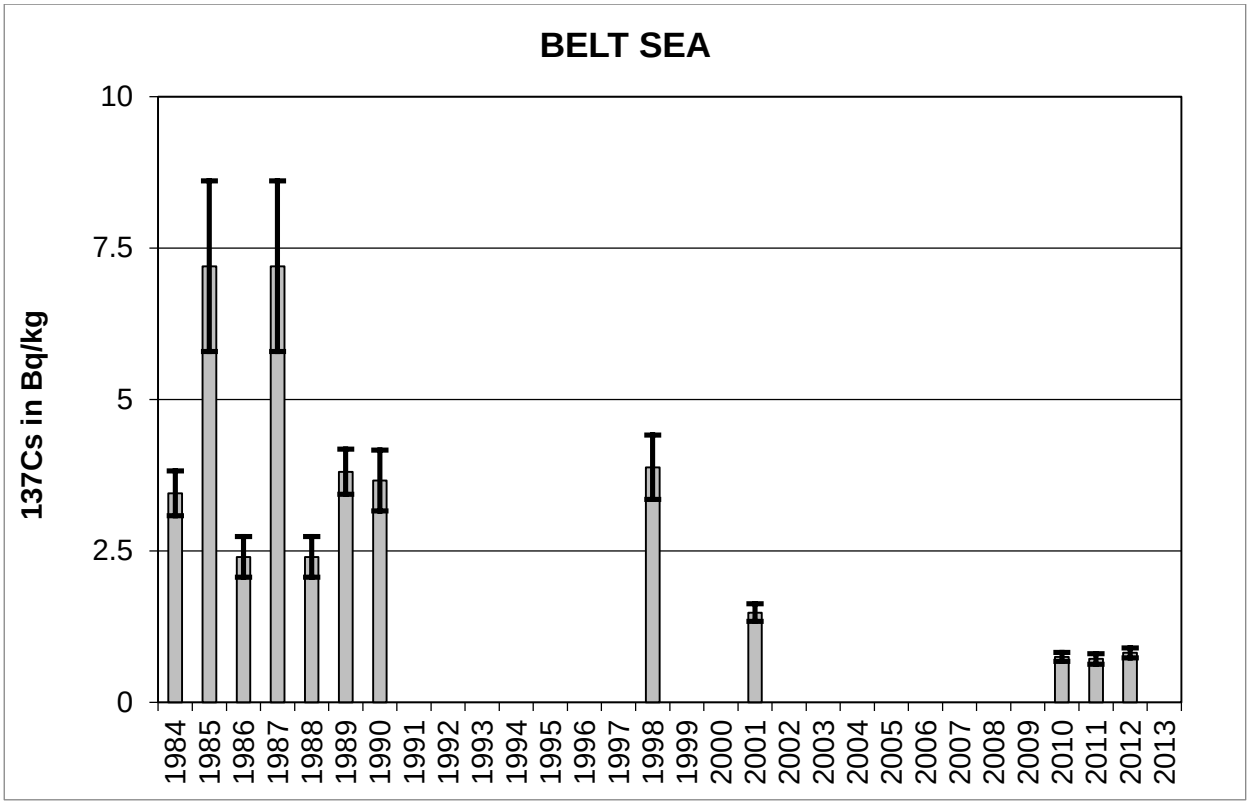


Figure 2g ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**BELT SEA**).

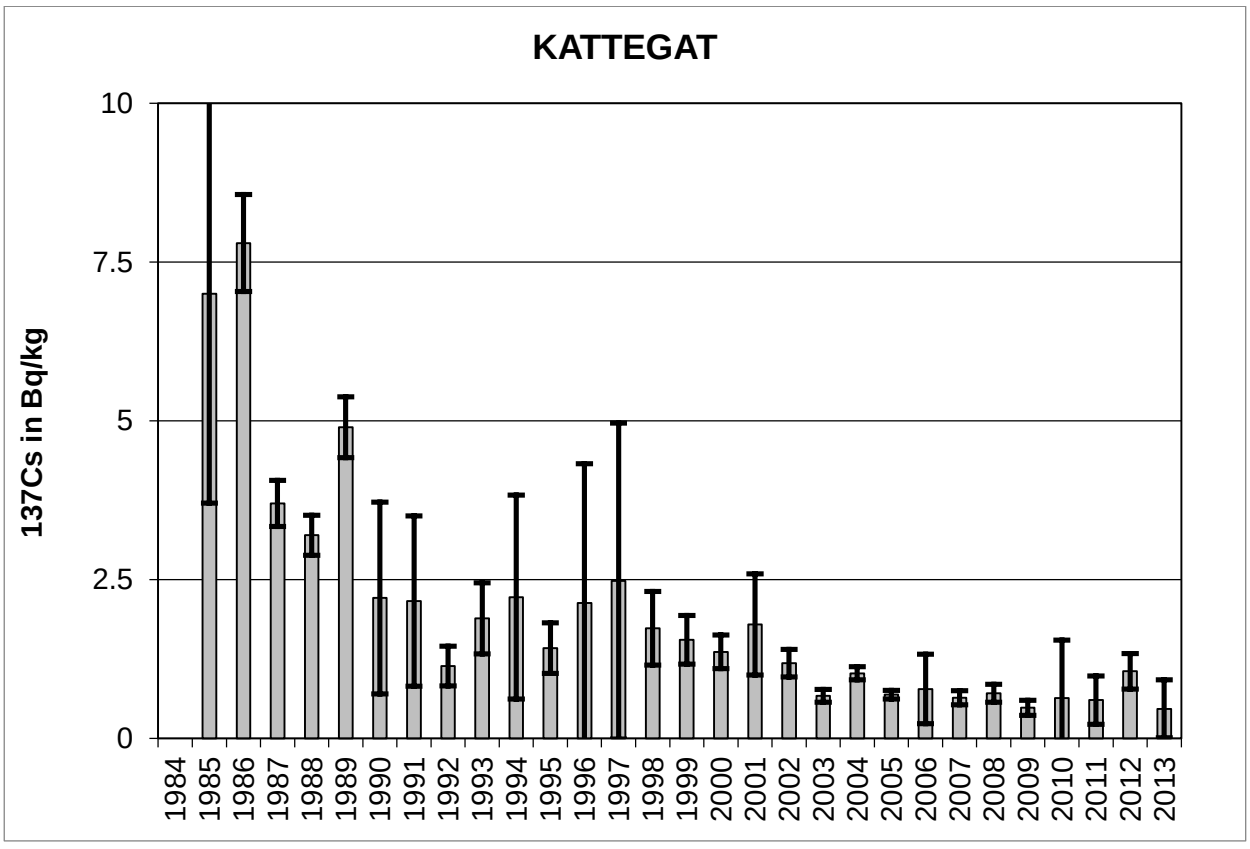


Figure 2h ^{137}Cs mean concentrations (in Bq kg^{-1}) in herring muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**KATTEGAT**).

BIOTA: HERRING Figures 3a-d. ^{90}Sr mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails or fillets (Arkona)) in 1984–2013, as annual mean by MORS subbasin.

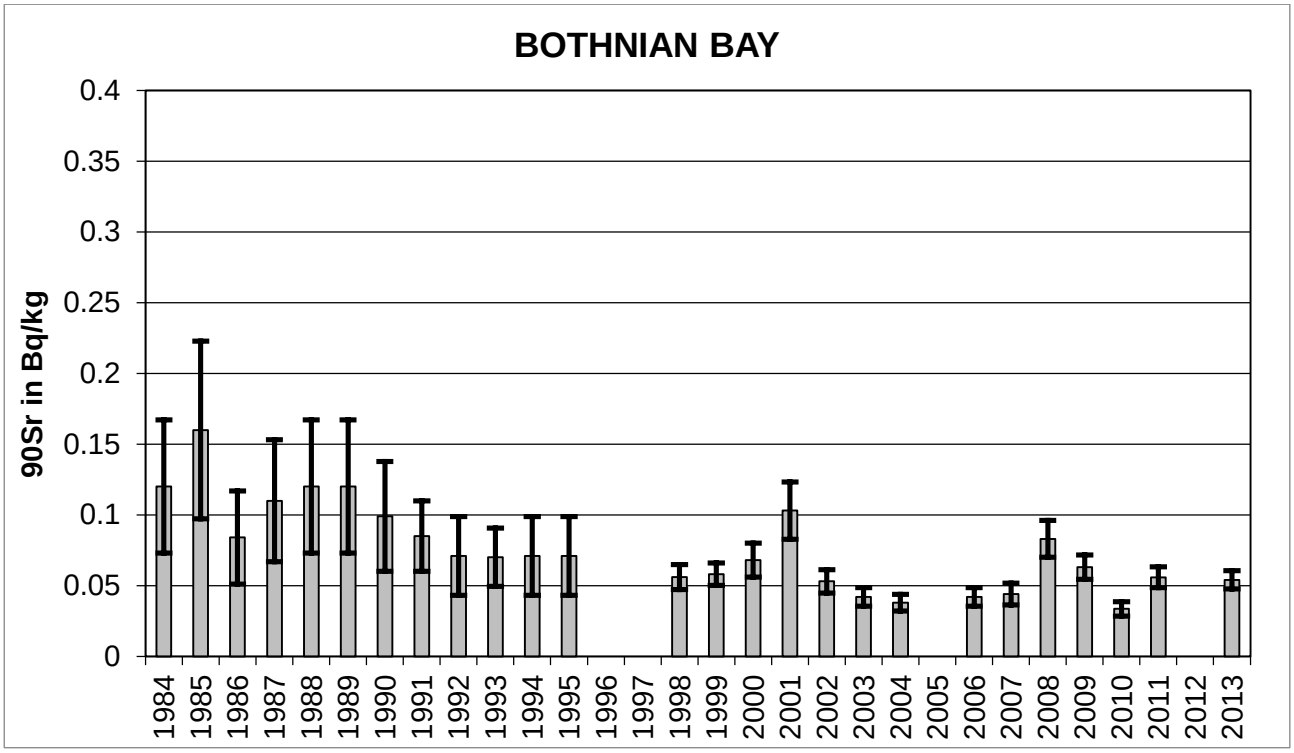


Figure 3a. ^{90}Sr mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**BOTHNIAN BAY**).

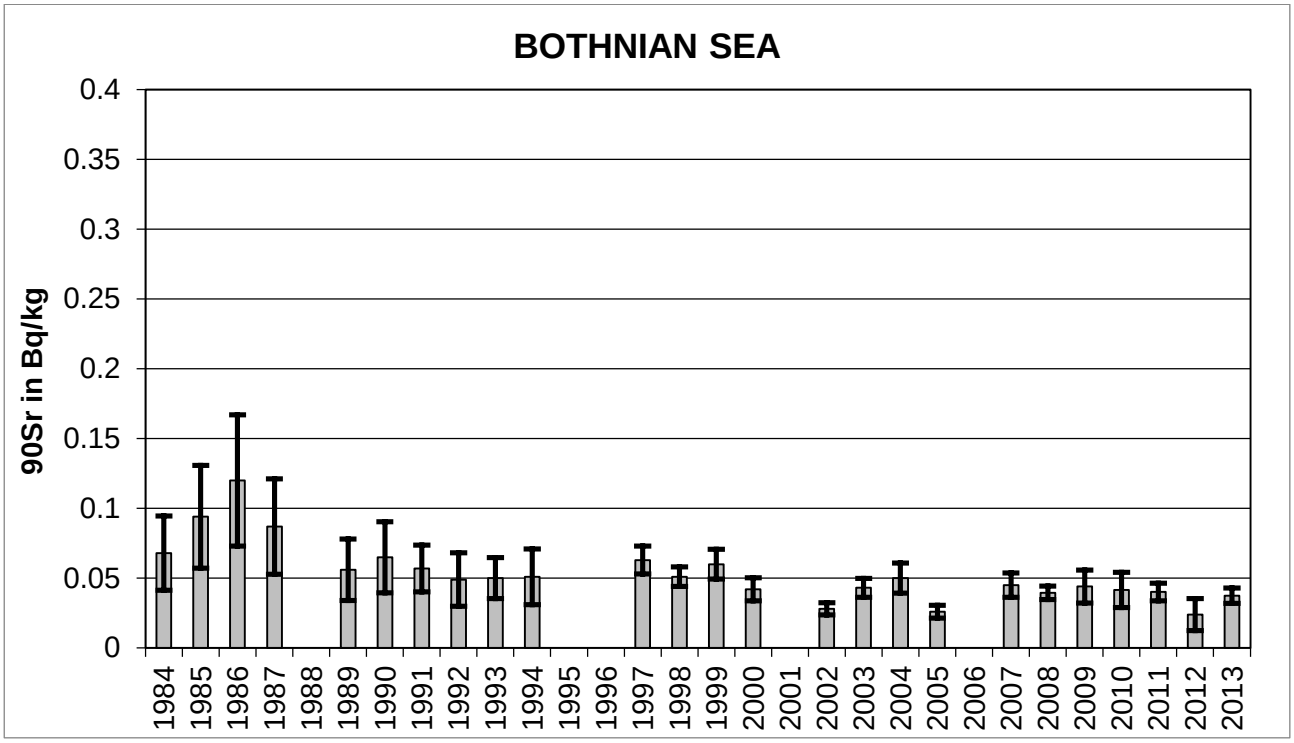


Figure 3b. ^{90}Sr mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**BOTHNIAN SEA**).

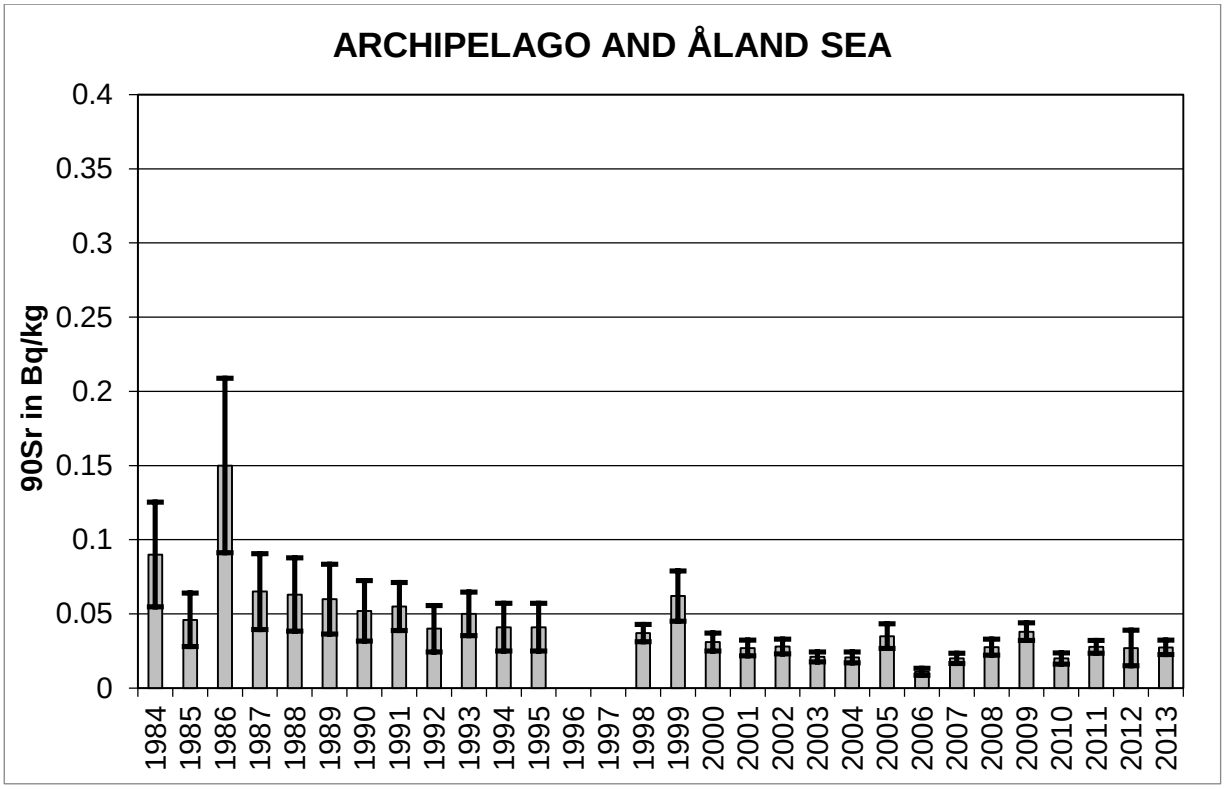


Figure 3c. ^{90}Sr mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**ARCHIPELAGO AND ÅLAND SEA**).

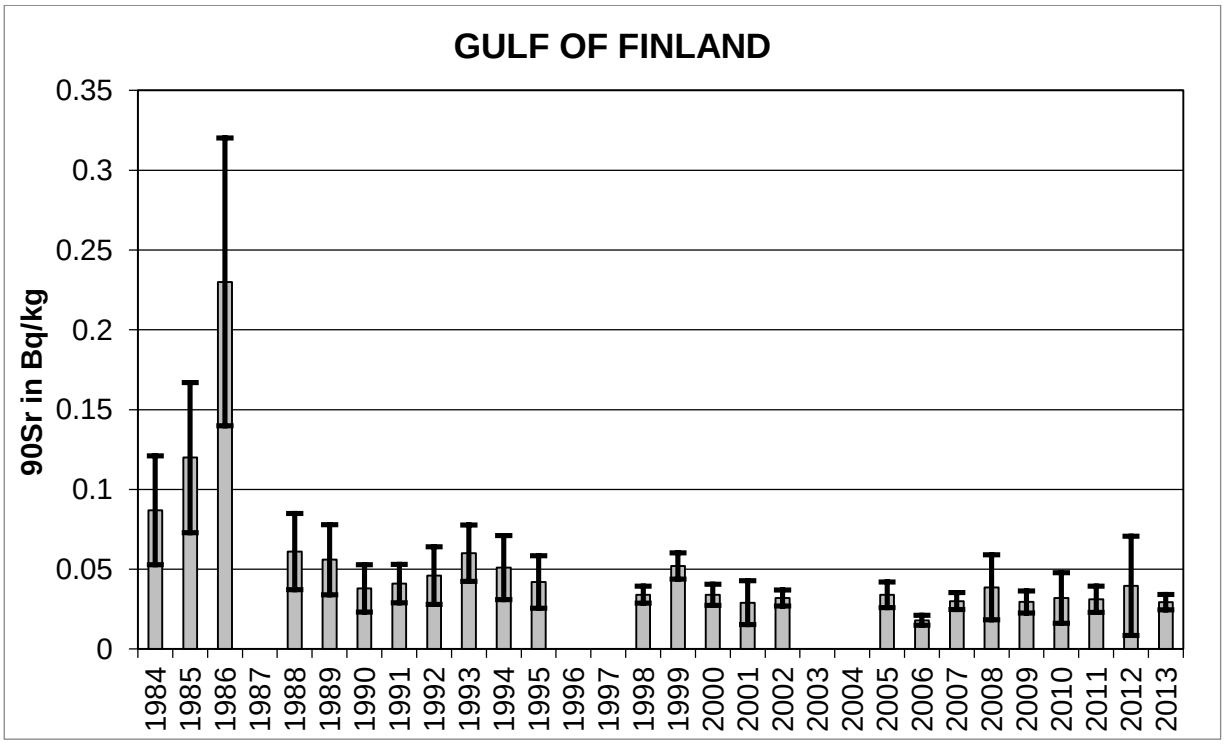


Figure 3d. ^{90}Sr mean concentrations (in Bq kg^{-1}) in herring muscle (without head and entrails) in 1984–2013, as annual mean by MORS subbasin (**GULF OF FINLAND**).

BIOTA: PLAICE AND FLOUNDER Figures 4a-e. ^{137}Cs mean concentrations (in Bq kg^{-1}) in plaice and flounder muscle (fillets or whole fish (Gulf of Finland)) in 1984–2013, as annual mean by MORS subbasin.

Figure 4a. ^{137}Cs mean concentrations (in Bq kg^{-1}) in plaice and flounder muscle (whole fish) in 1984–2013, as annual mean by MORS subbasin (**GULF OF FINLAND**)

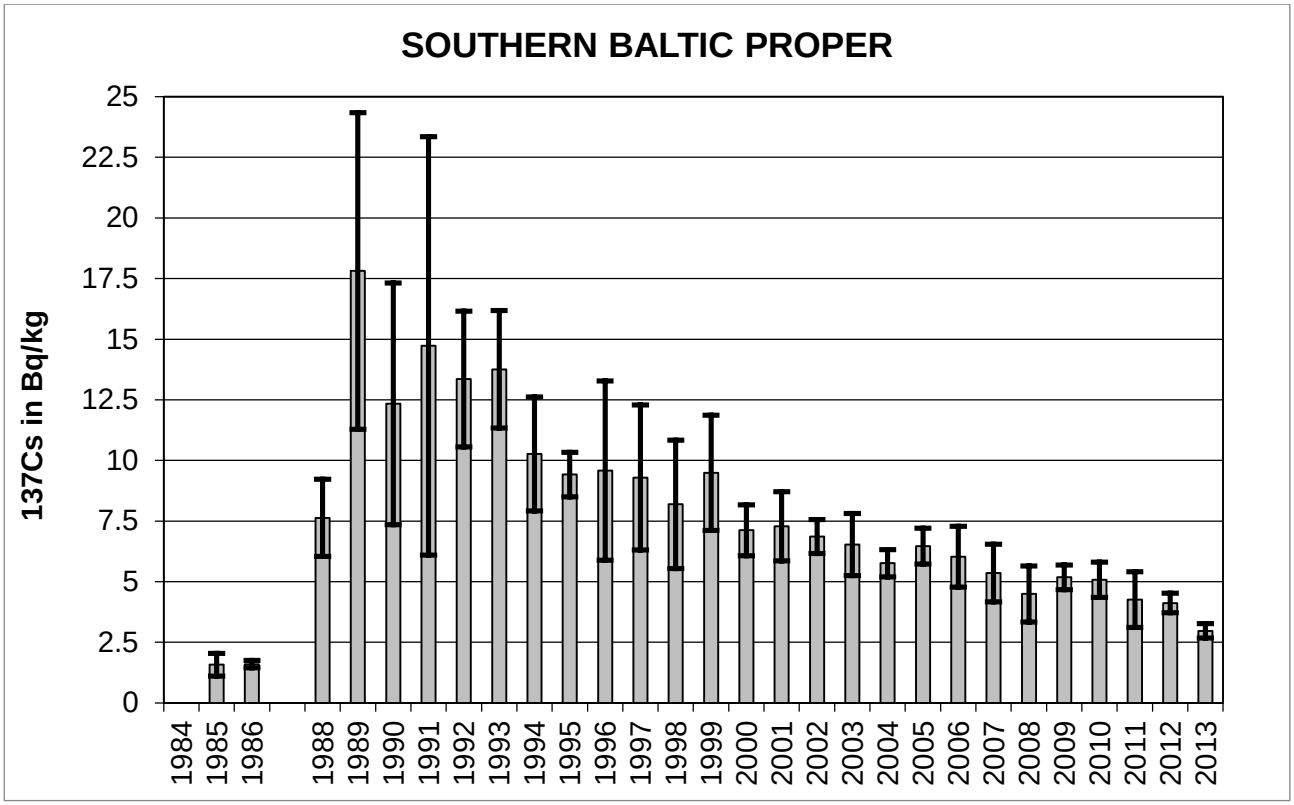


Figure 4b. ^{137}Cs mean concentrations (in Bq kg^{-1}) in plaice and flounder muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**SOUTHERN BALTIC PROPER**)

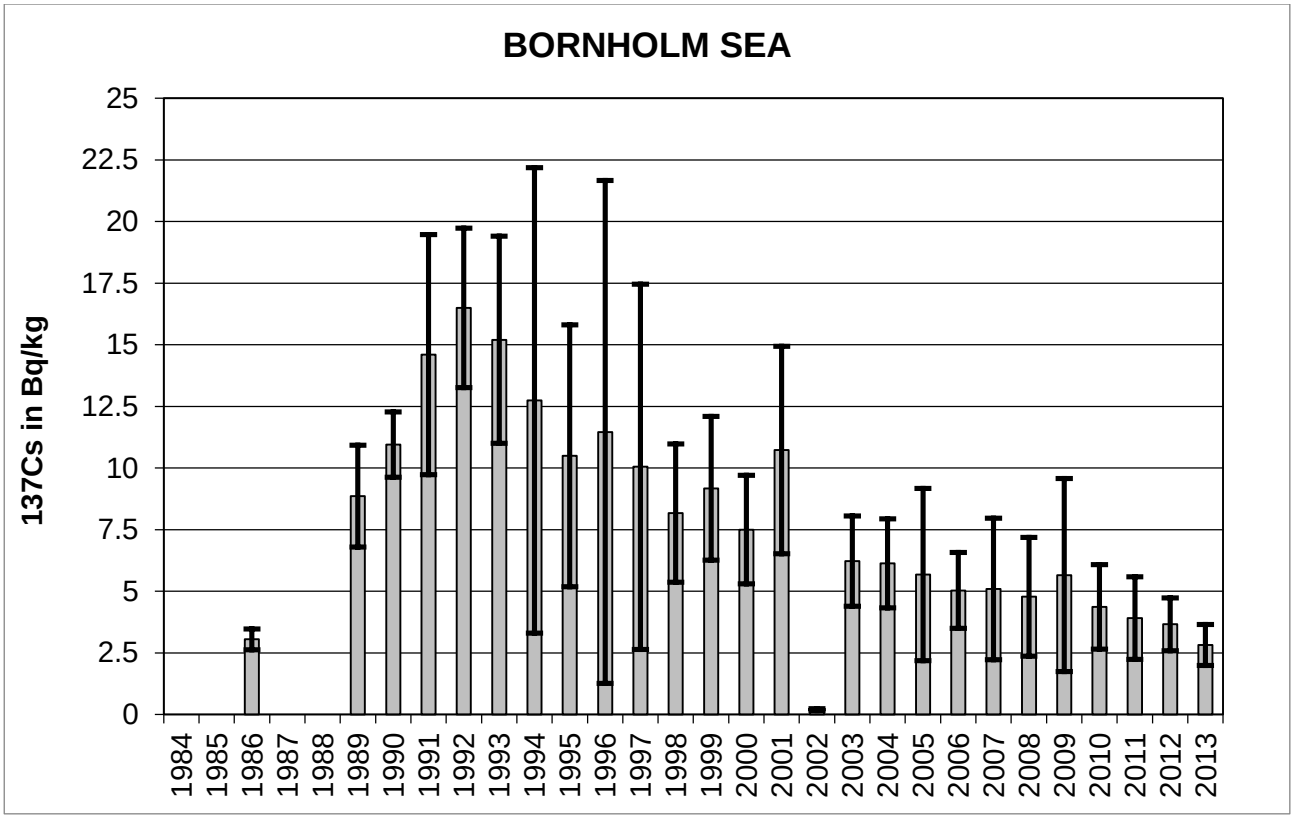


Figure 4c. ^{137}Cs mean concentrations (in Bq kg^{-1}) in plaice and flounder muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**BORNHOLM SEA**)

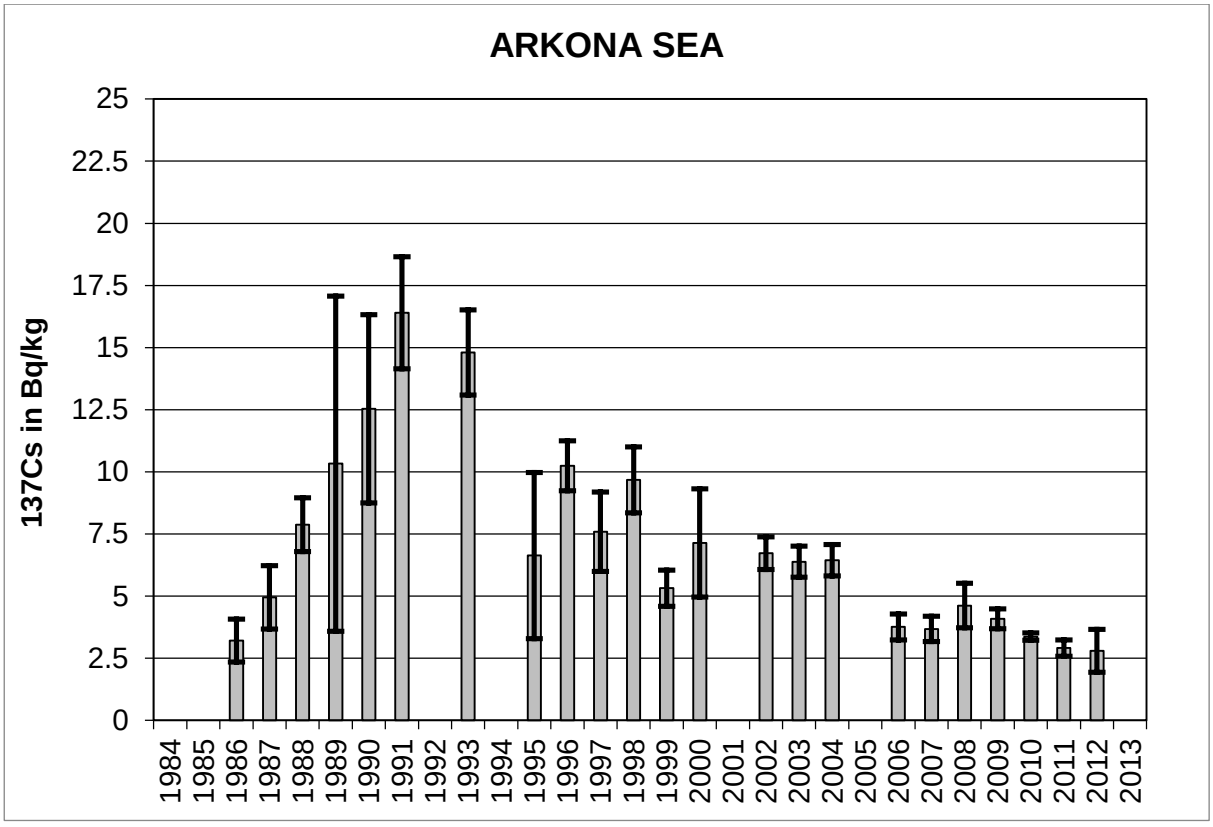


Figure 4d. ^{137}Cs mean concentrations (in Bq kg^{-1}) in plaice and flounder muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**ARKONA SEA**)

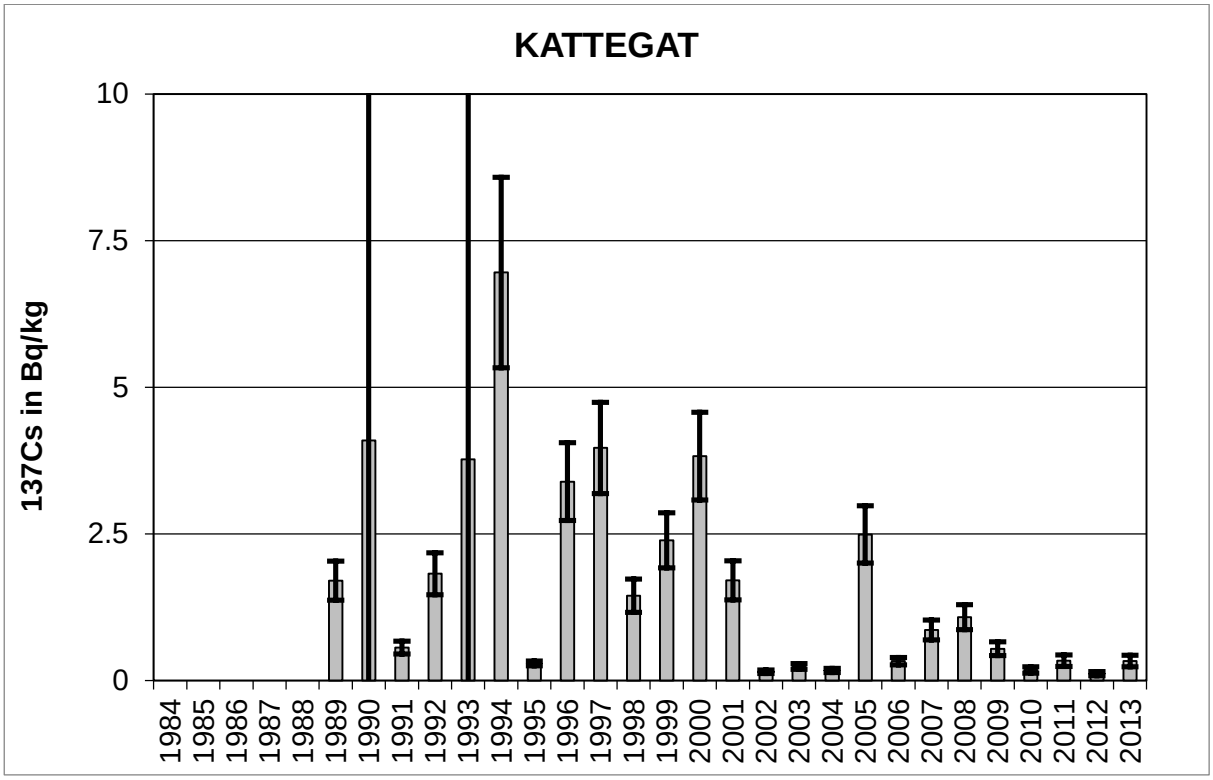


Figure 4e. ^{137}Cs mean concentrations (in Bq kg^{-1}) in plaice and flounder muscle (fillets) in 1984–2013, as annual mean by MORS subbasin (**KATTEGAT**)

BIOTA: COD Figures 5a-e. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasin.

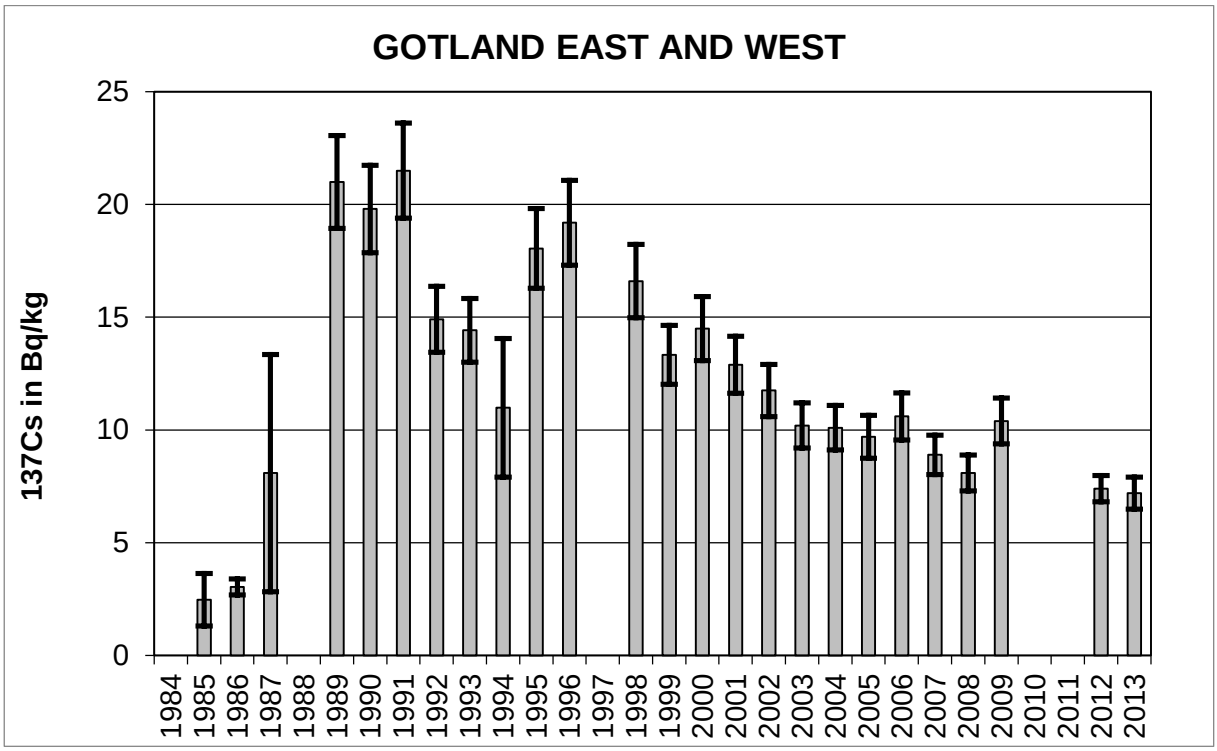


Figure 5a. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasins (**GOTLAND EAST AND WEST**).

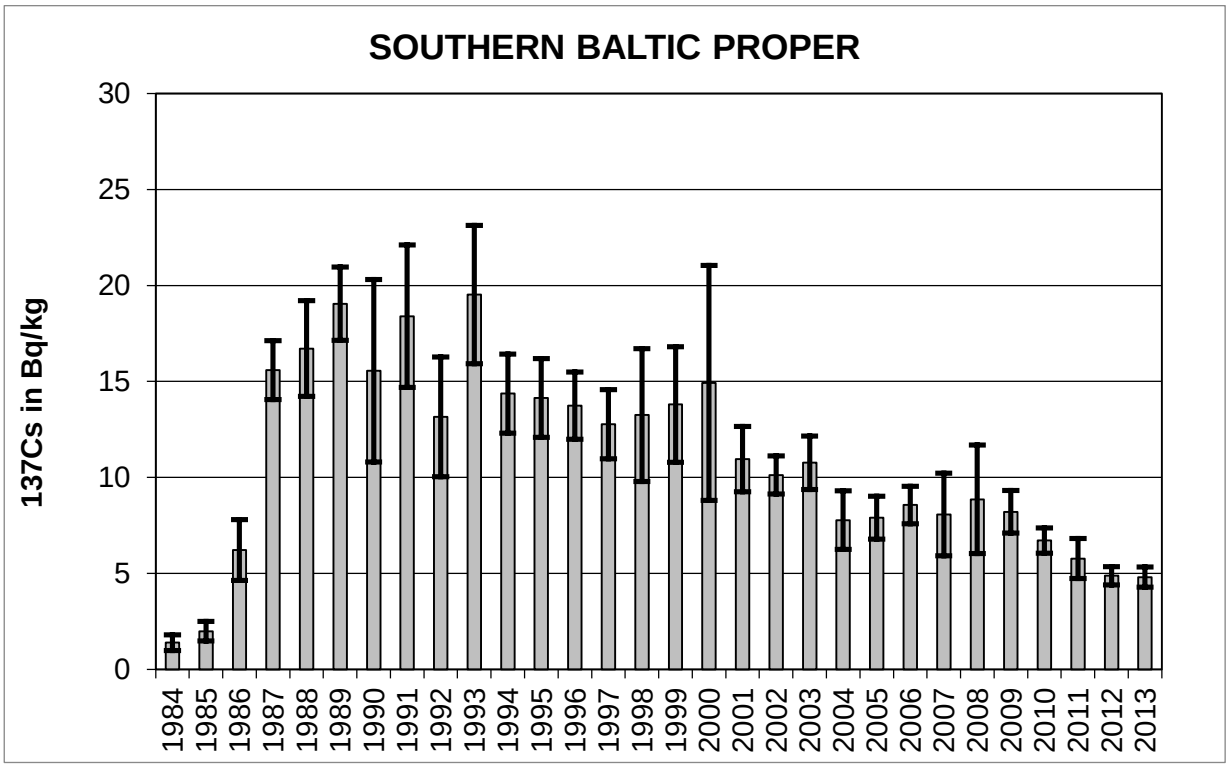


Figure 5b. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasins (**SOUTHERN BALTIC PROPER**).

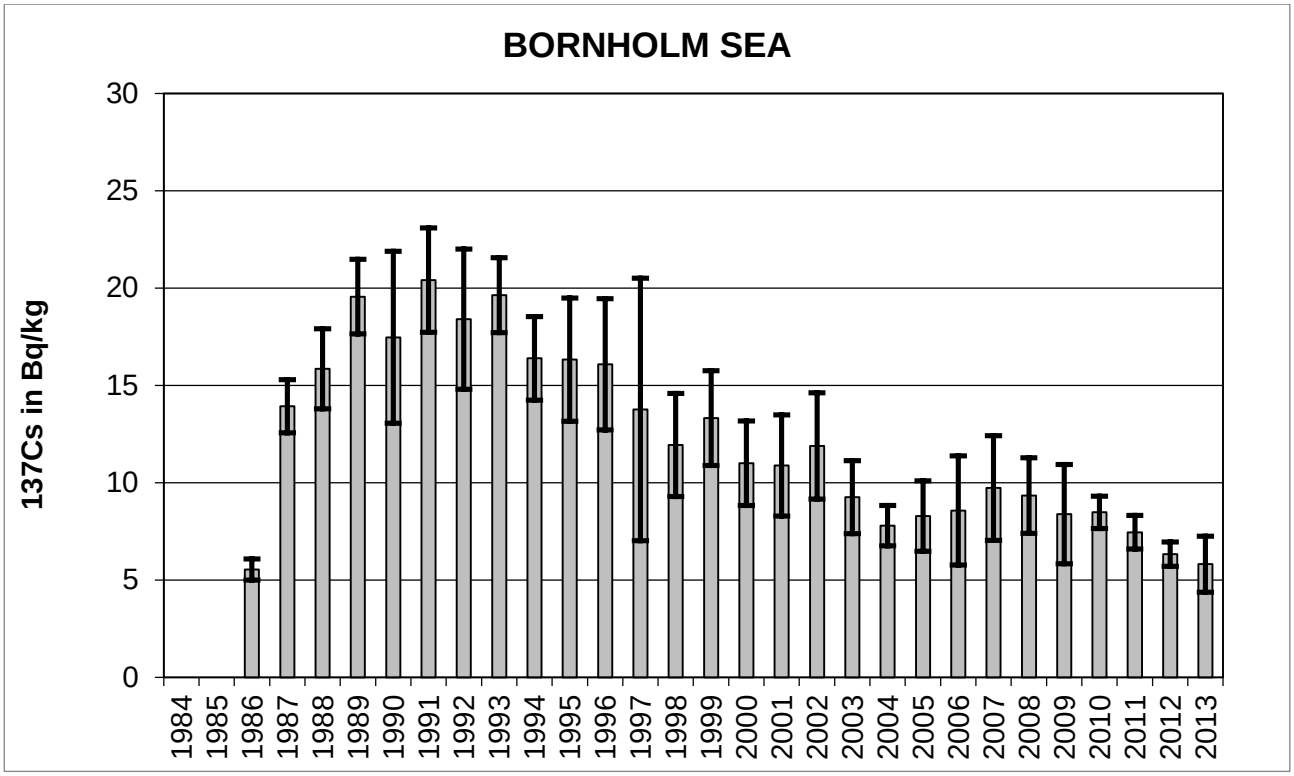


Figure 5c. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasins (**BORNHOLM SEA**).

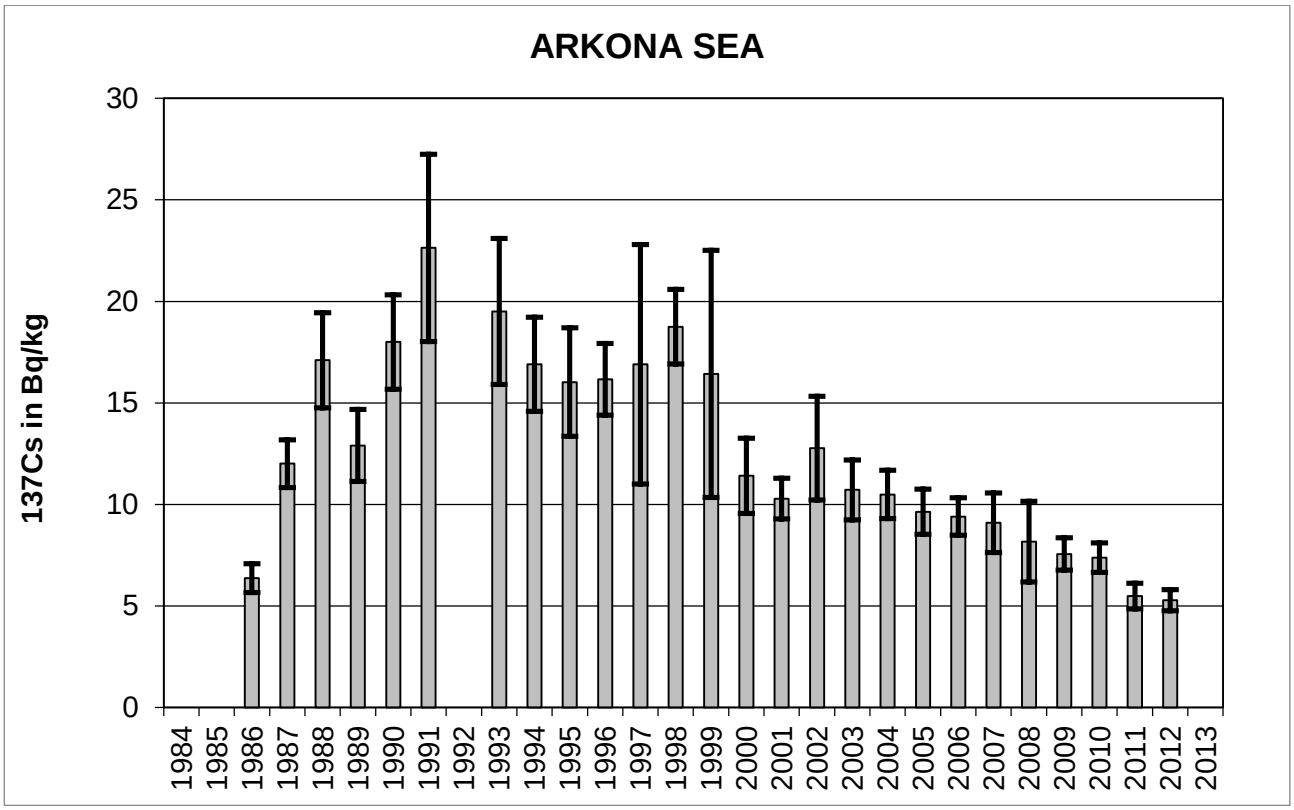


Figure 5d. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasins (**ARKONA SEA**).

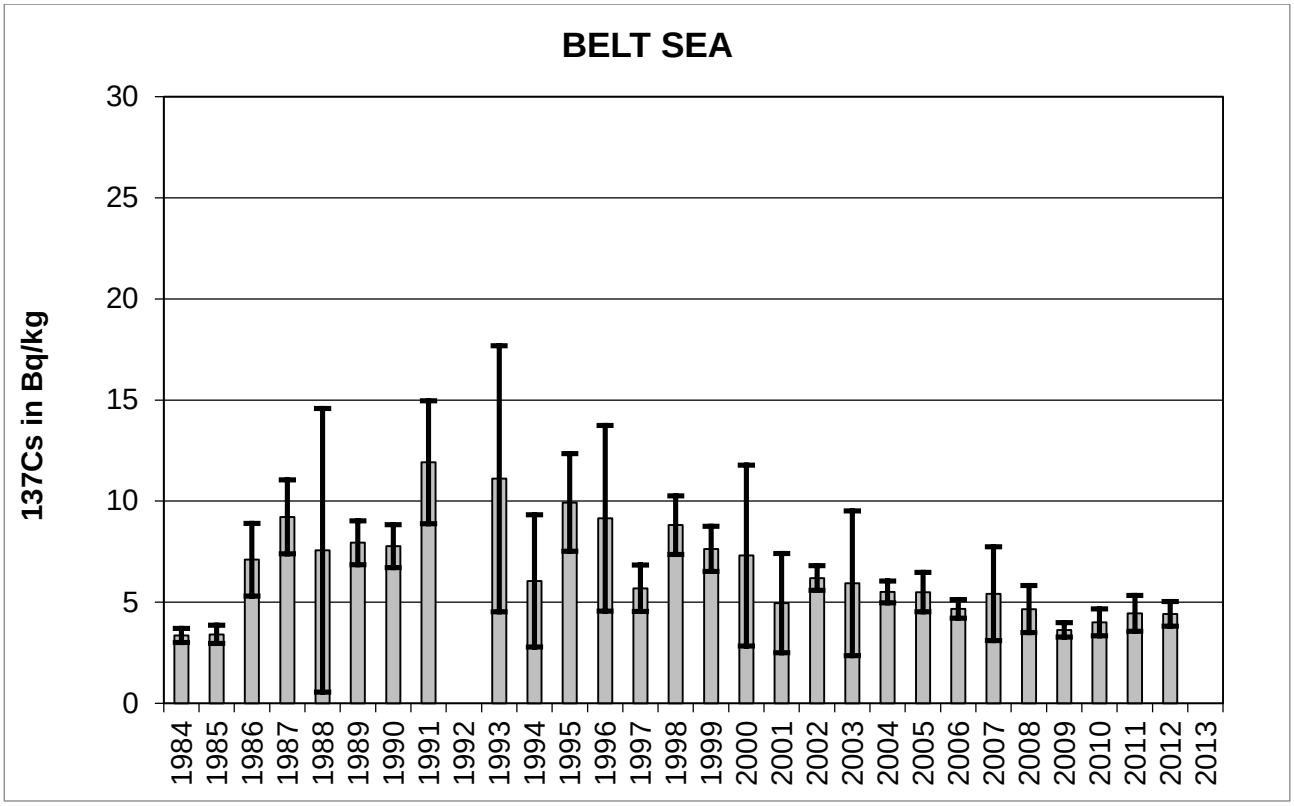


Figure 5e. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasins (**BELT SEA**).

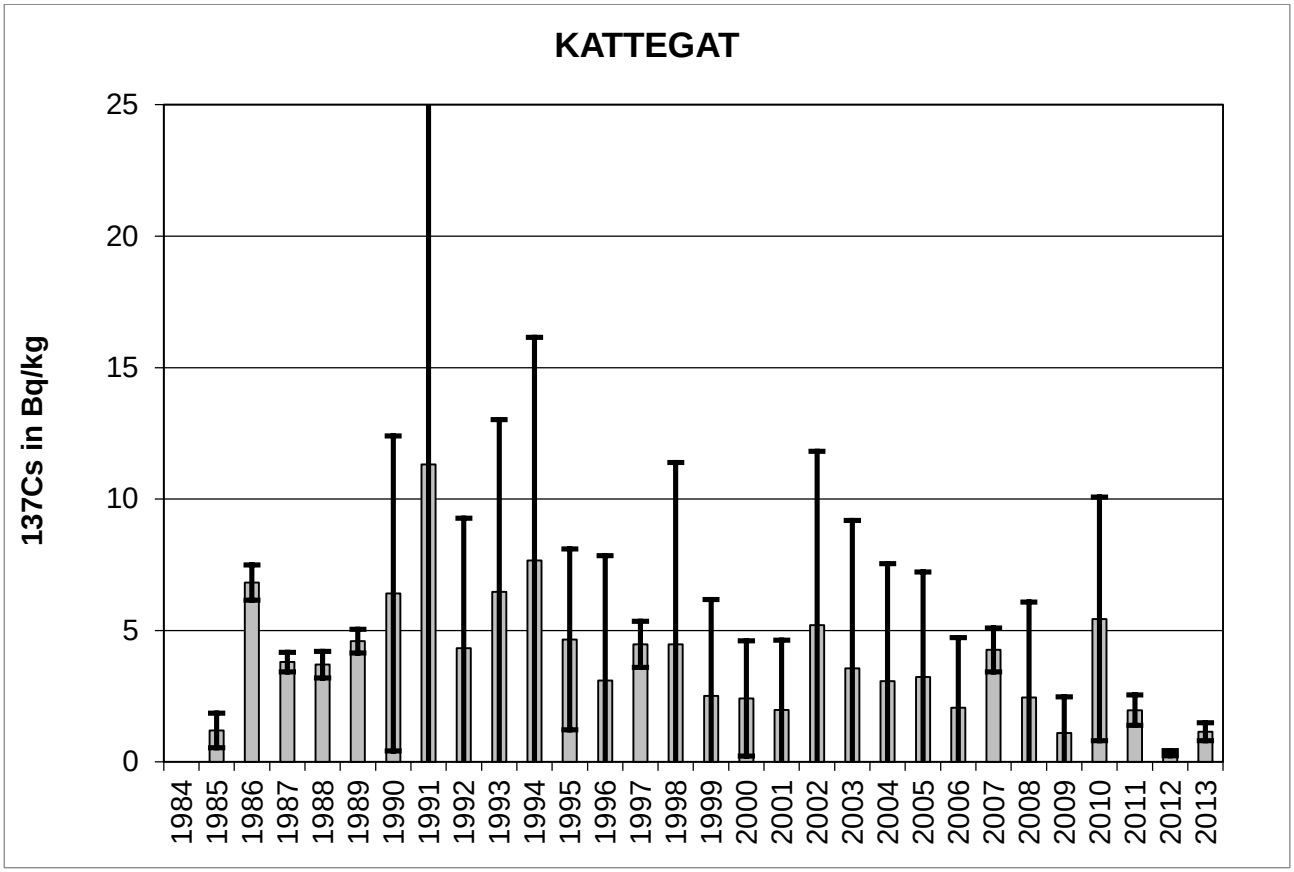


Figure 5f. ^{137}Cs mean concentrations (in Bq kg^{-1}) in cod muscle (fillets) in 1984–2013, as annual mean by MORS subbasins (**KATTEGAT**).

BIOTA: BLADDER WRACK (FUCUS VESICULOSUS) Figures 6a-g. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin.

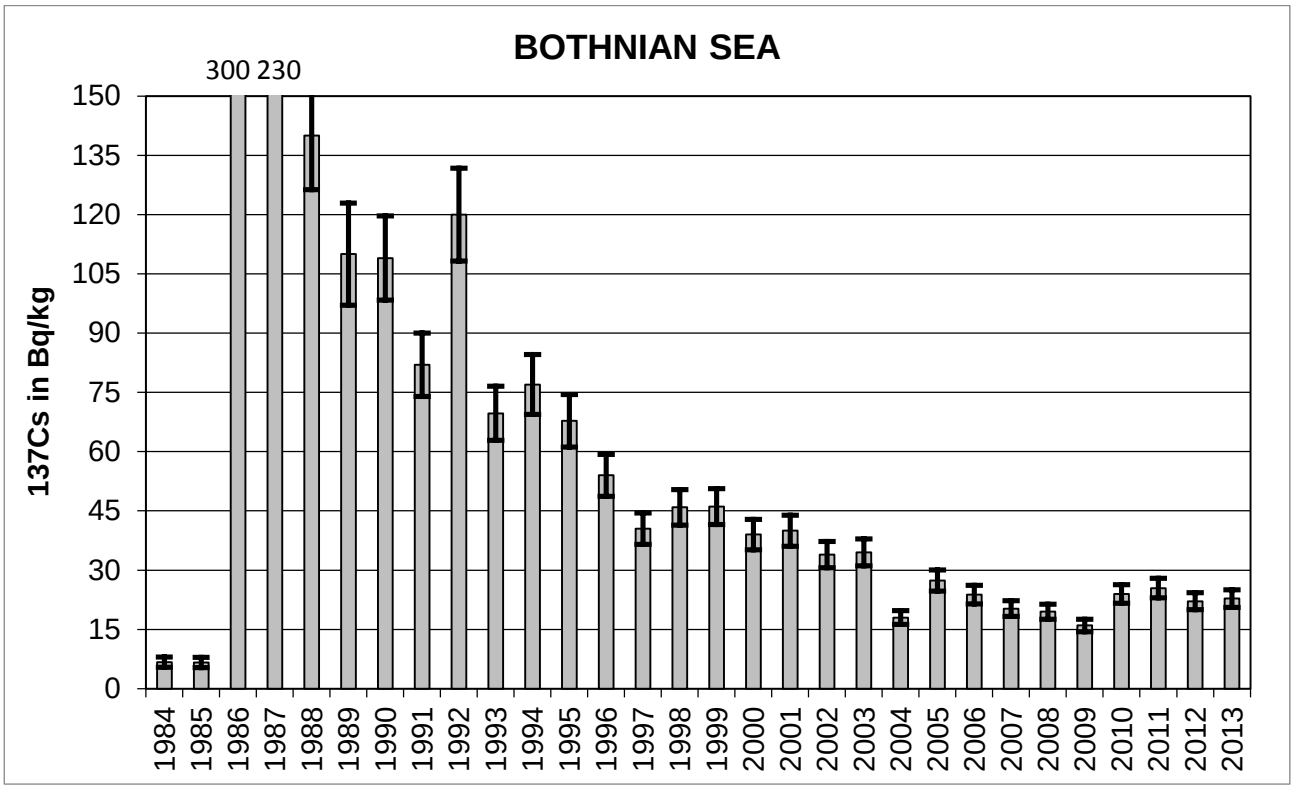


Figure 6a. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**BOTHNIAN SEA).**

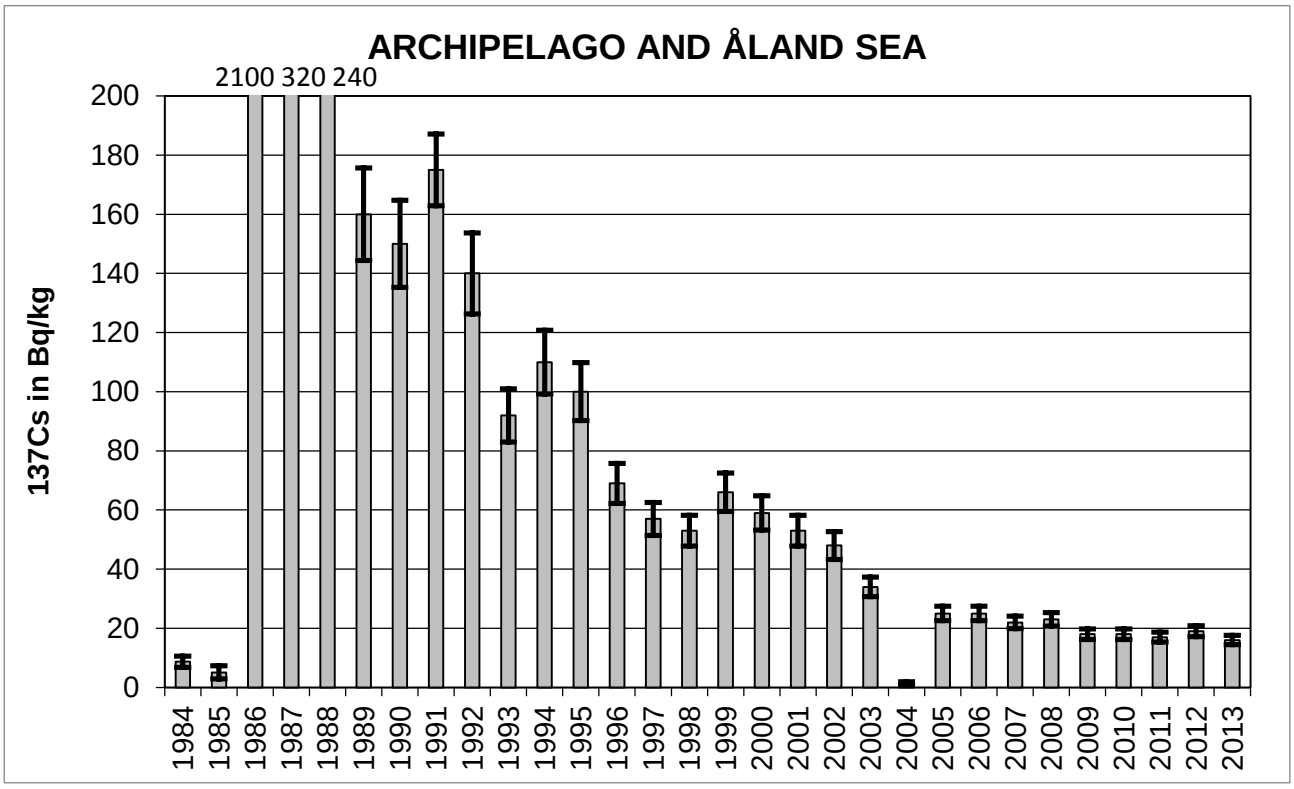


Figure 6b. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**ARCHIPELAGO AND ÅLAND SEA).**

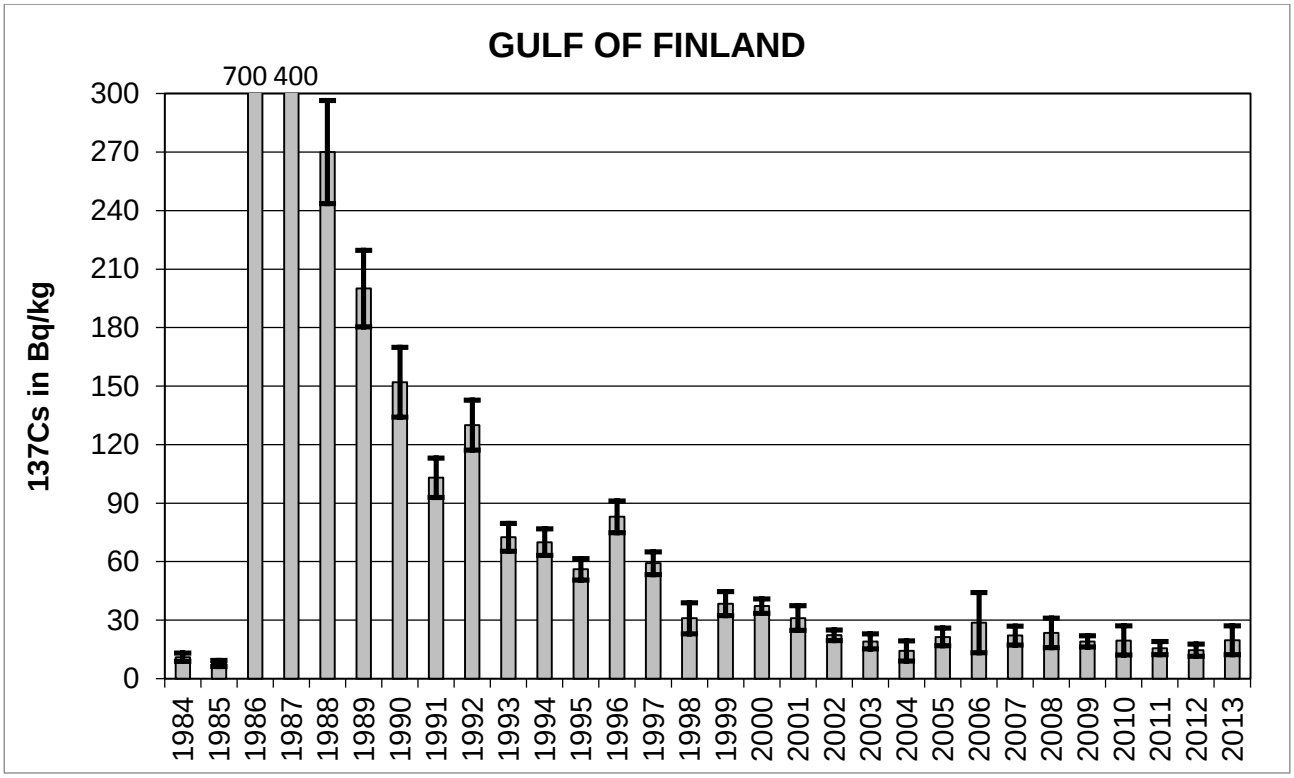


Figure 6c. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**GULF OF FINLAND).**

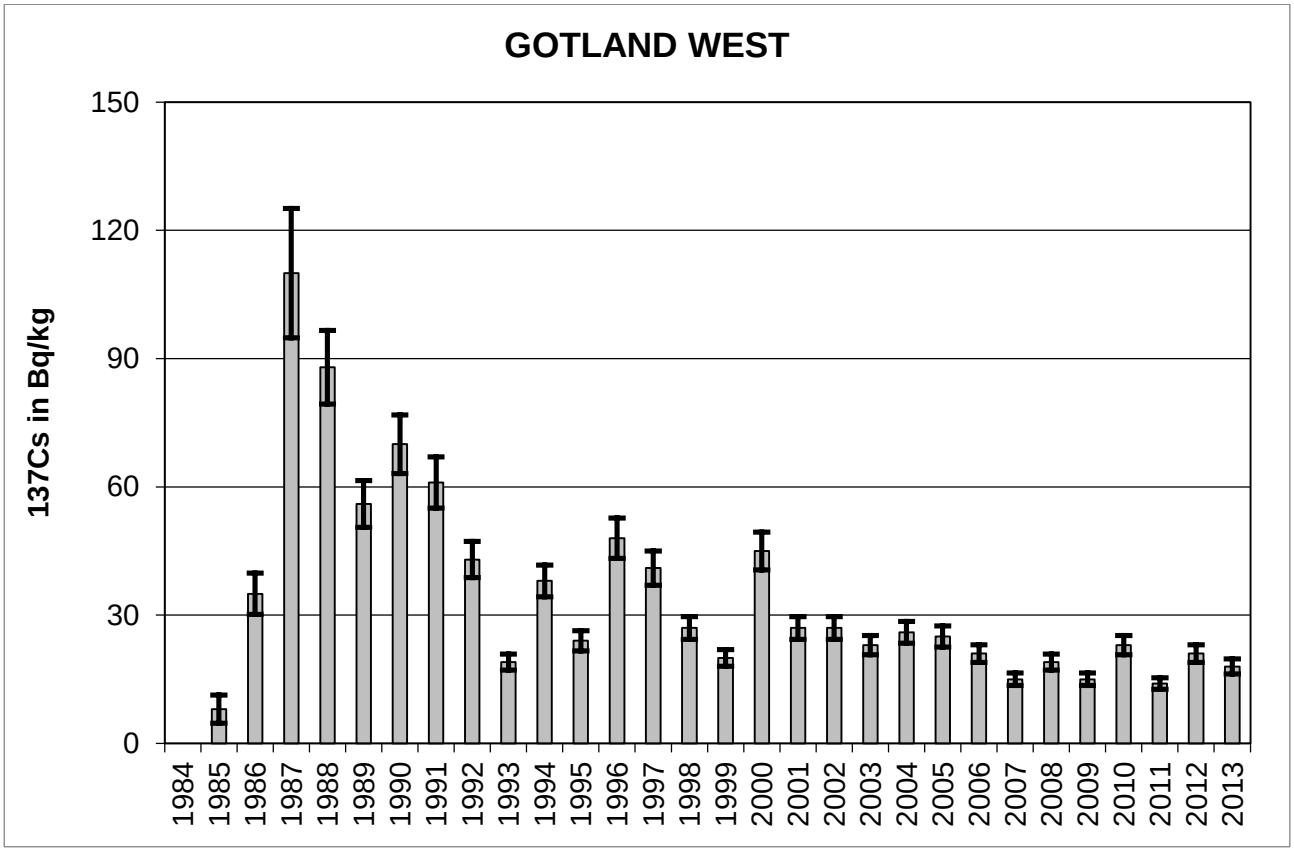


Figure 6d. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**GOTLAND WEST).**

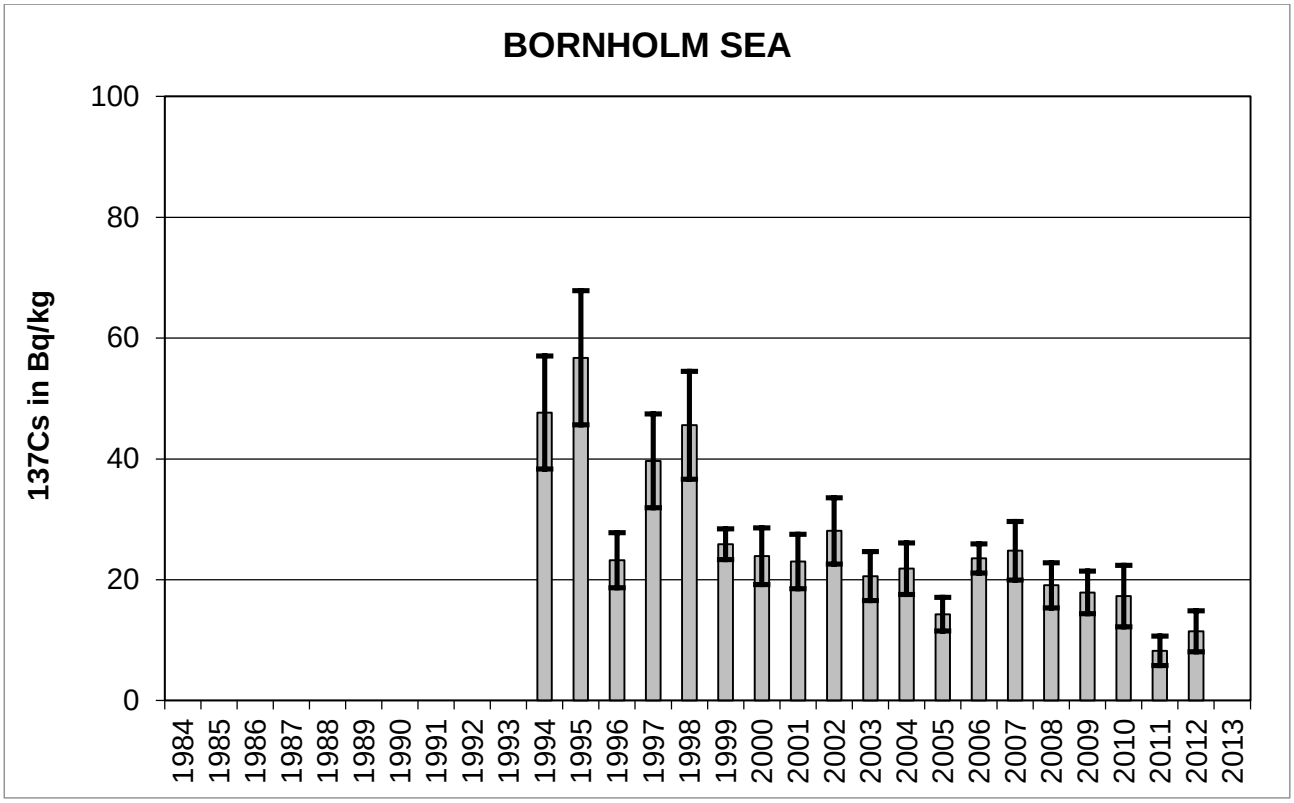


Figure 6e. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**BORNHOLM SEA).**

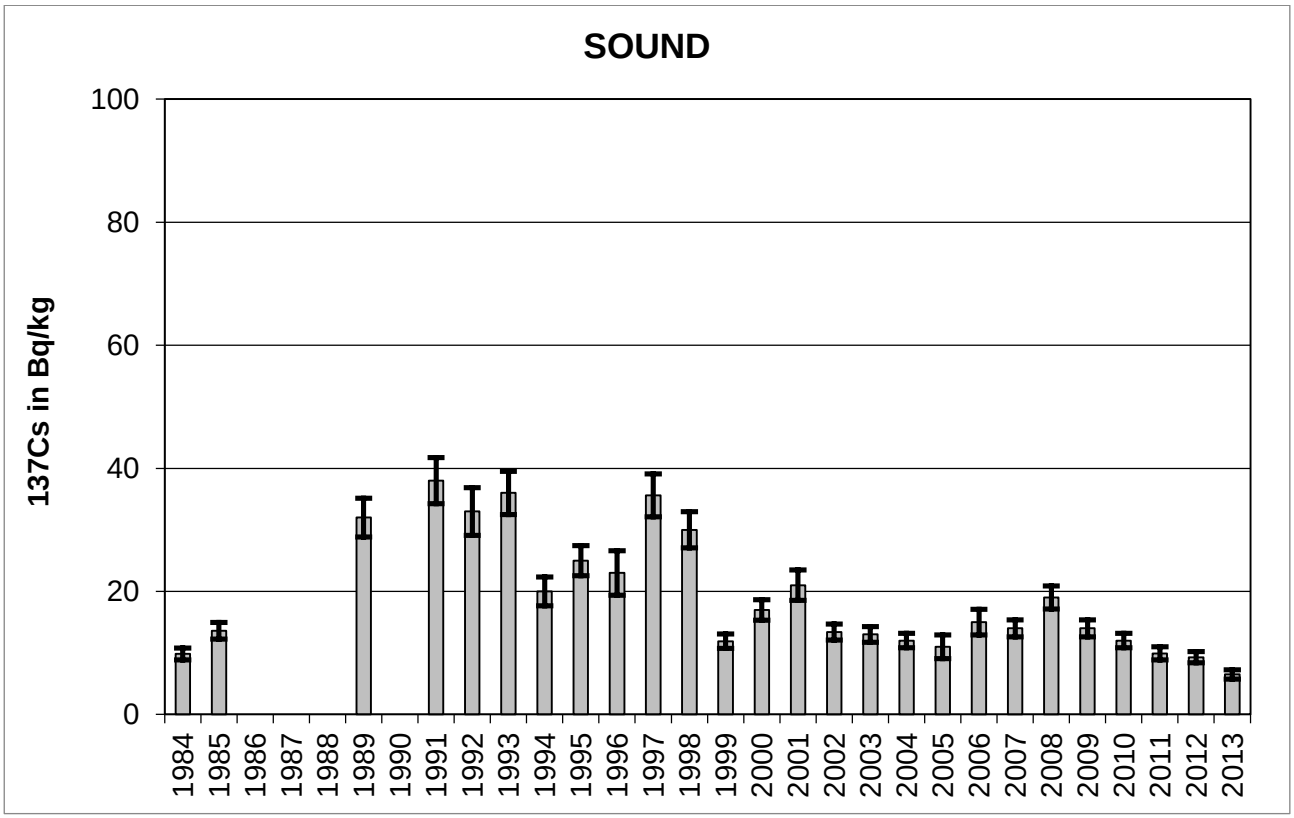


Figure 6f. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**SOUND).**

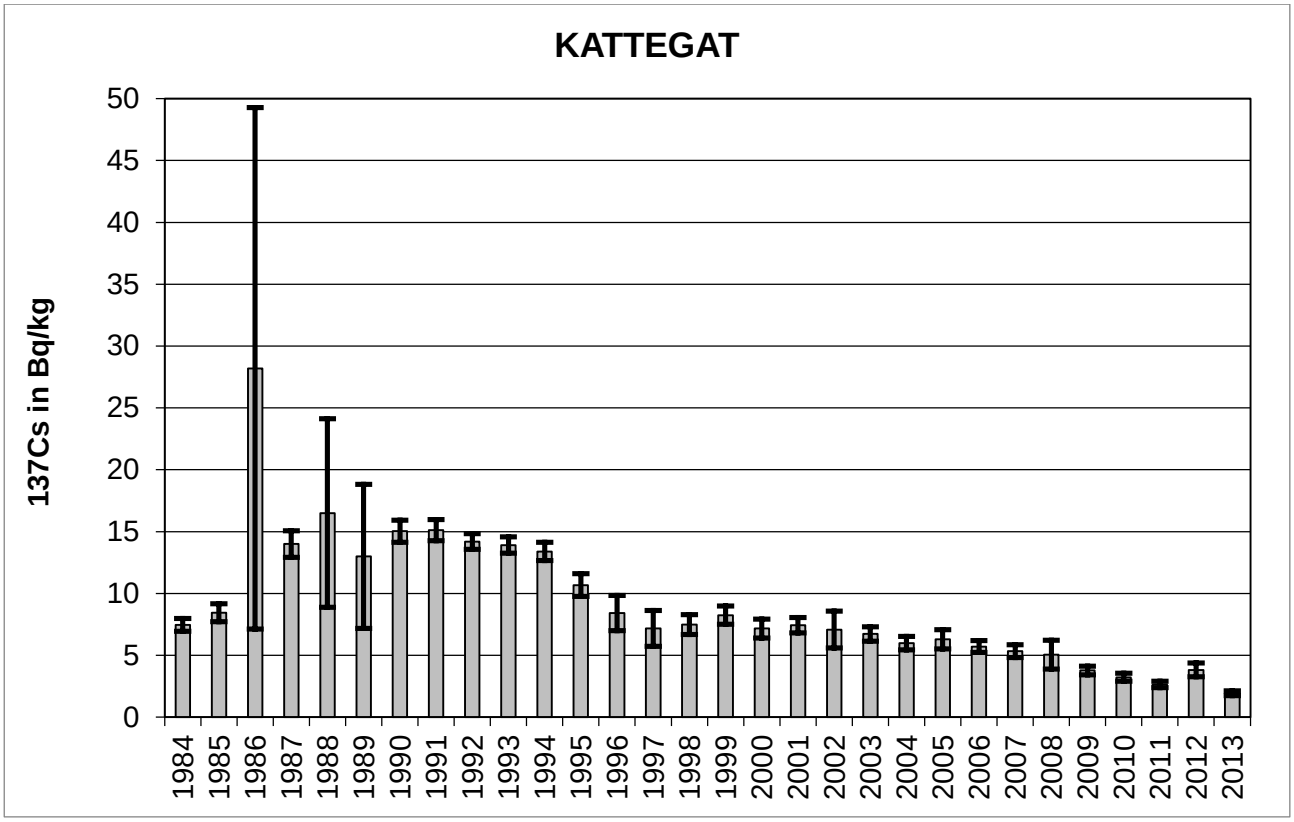


Figure 6g. ^{137}Cs mean concentrations (in Bq kg^{-1}) in *Fucus vesiculosus* in 1984–2013, as annual mean by MORS subbasin (**KATTEGAT).**

SEAWATER SURFACE: Figures 7a-m. ^{137}Cs (Bq/m^3) in surface water 1984-2013

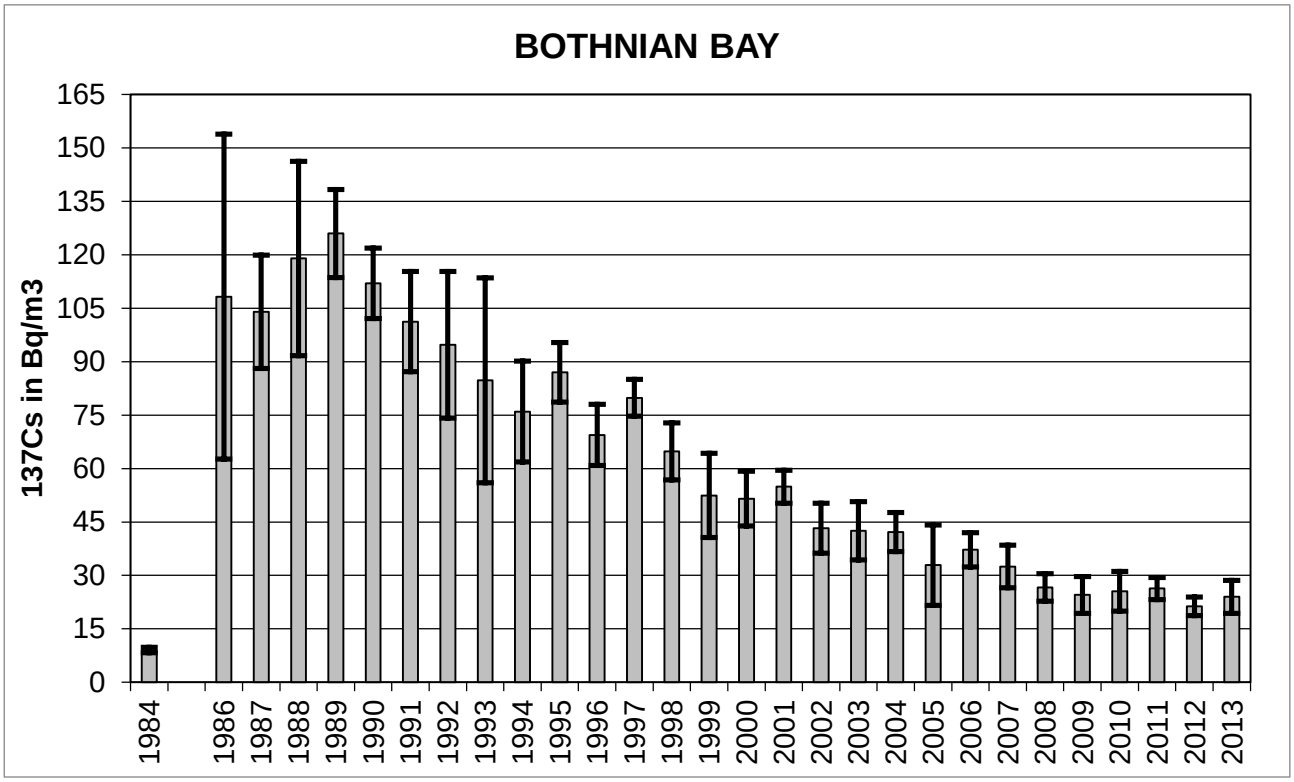


Figure 7a. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Bothnian Bay.

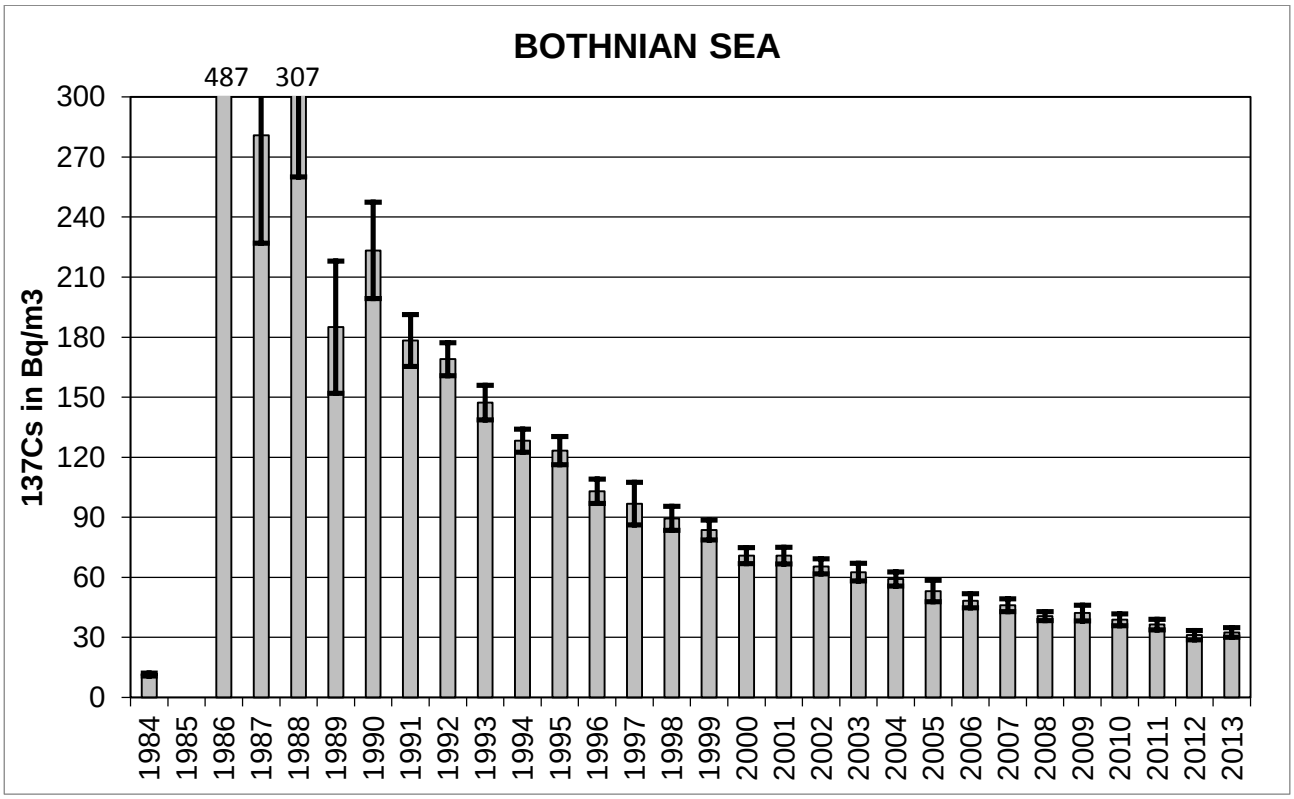


Figure 7b. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Bothnian Sea.

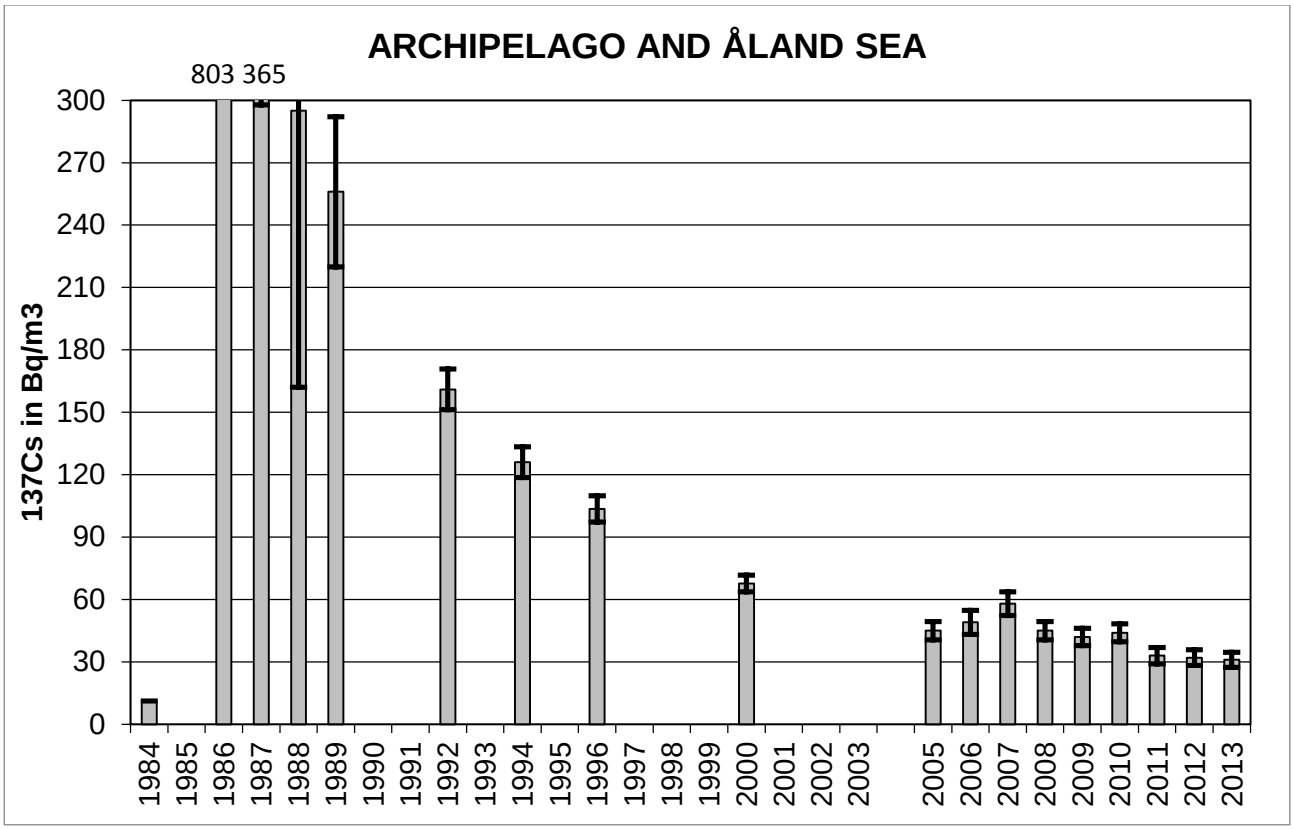


Figure 7c. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Archipelago and Åland Sea.

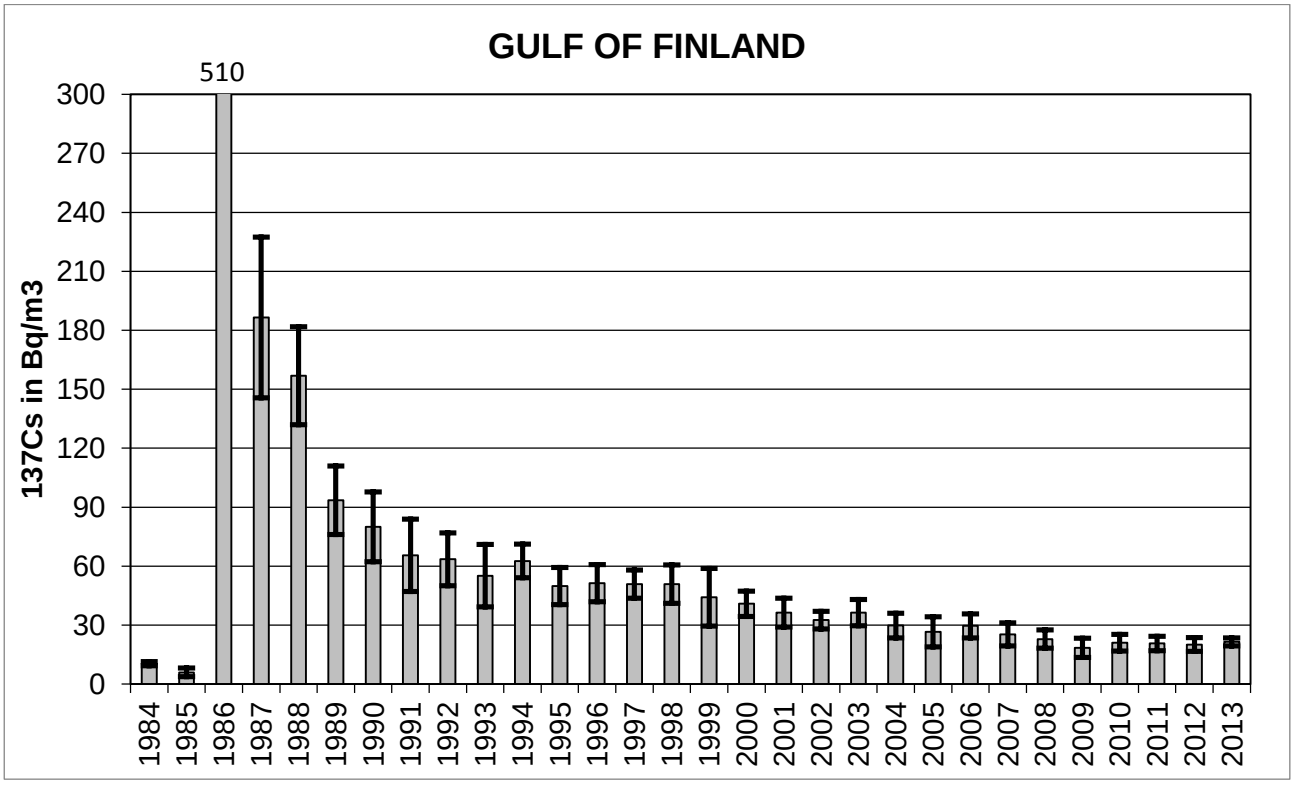


Figure 7d. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Gulf of Finland.

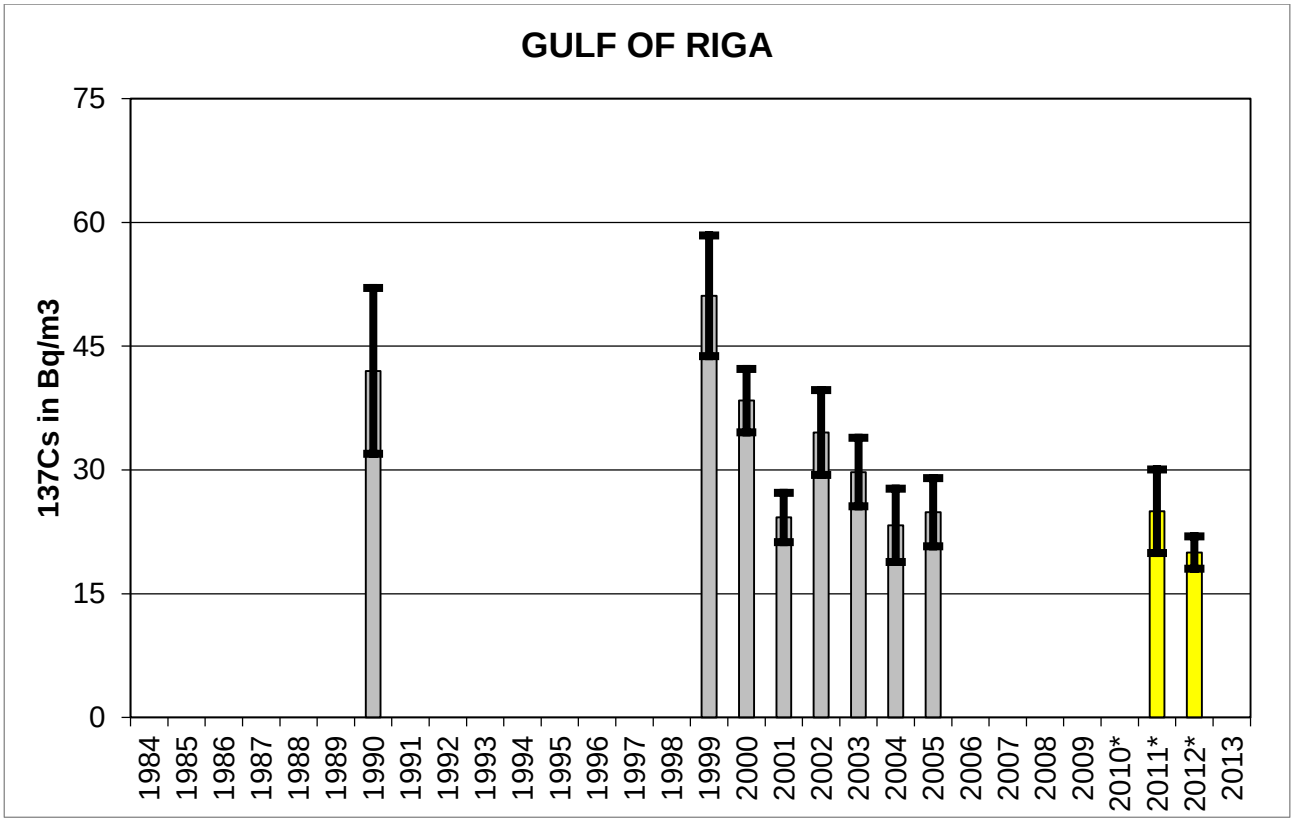


Figure 7e. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Gulf of Riga. Years containing values below limit of detection are indicated with asterisk (*) and yellow bar.

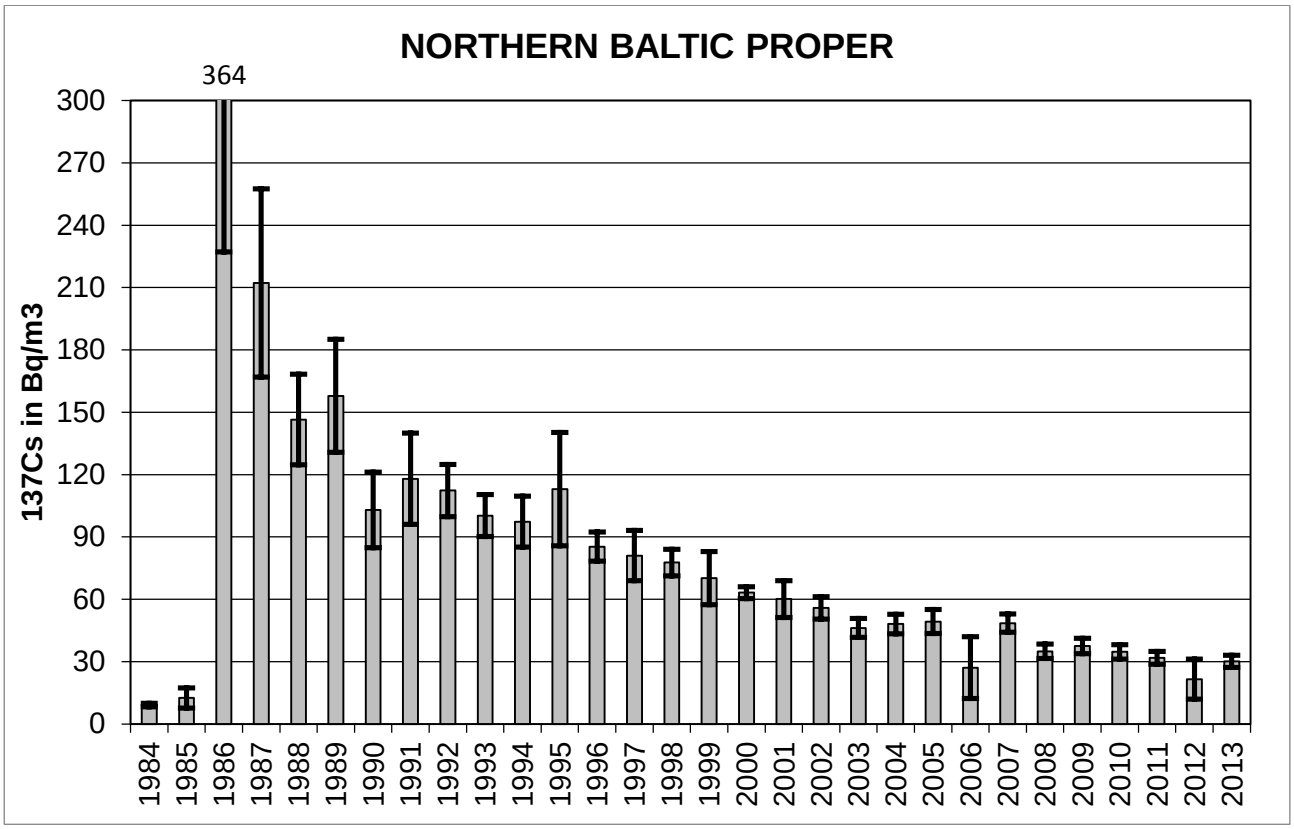


Figure 7f. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Northern Baltic Proper.

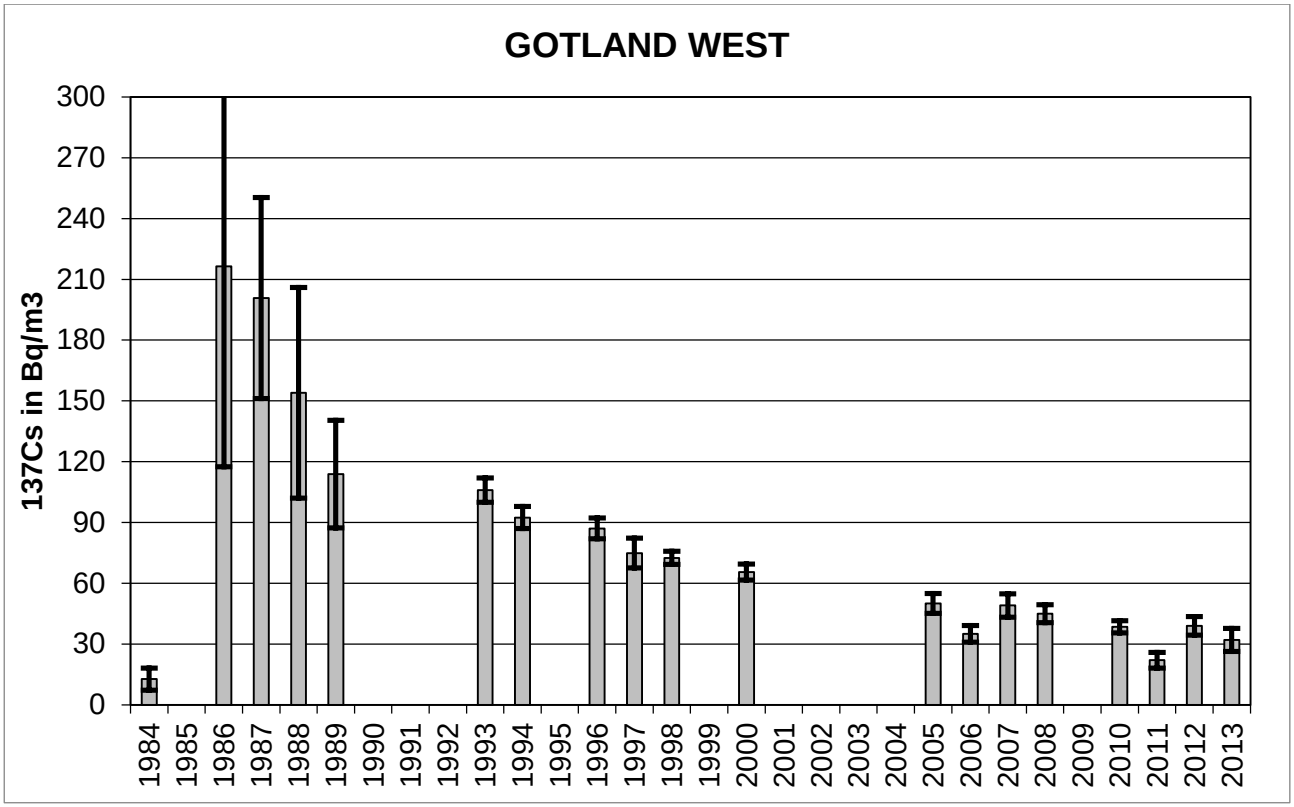


Figure 7g. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Gotland West.

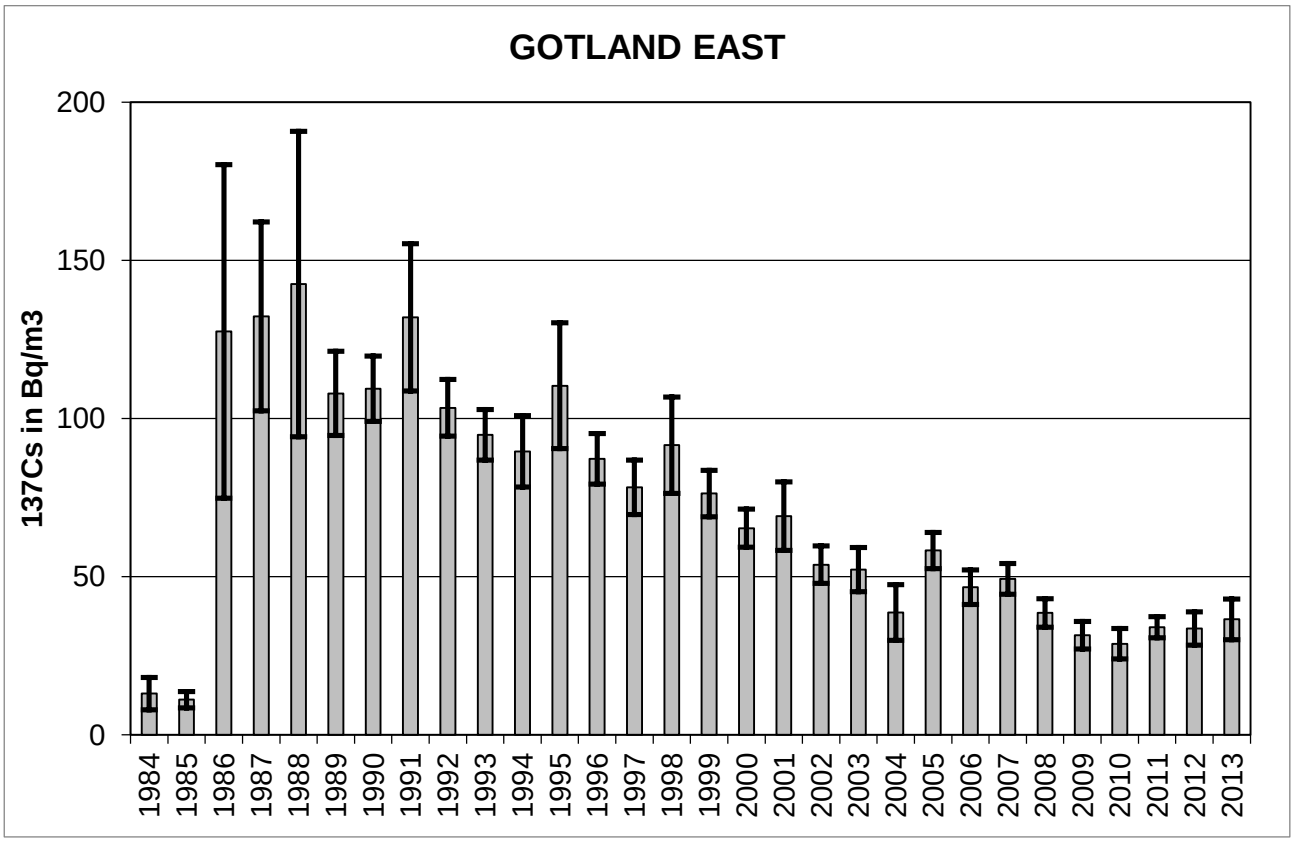


Figure 7h. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Gotland West.

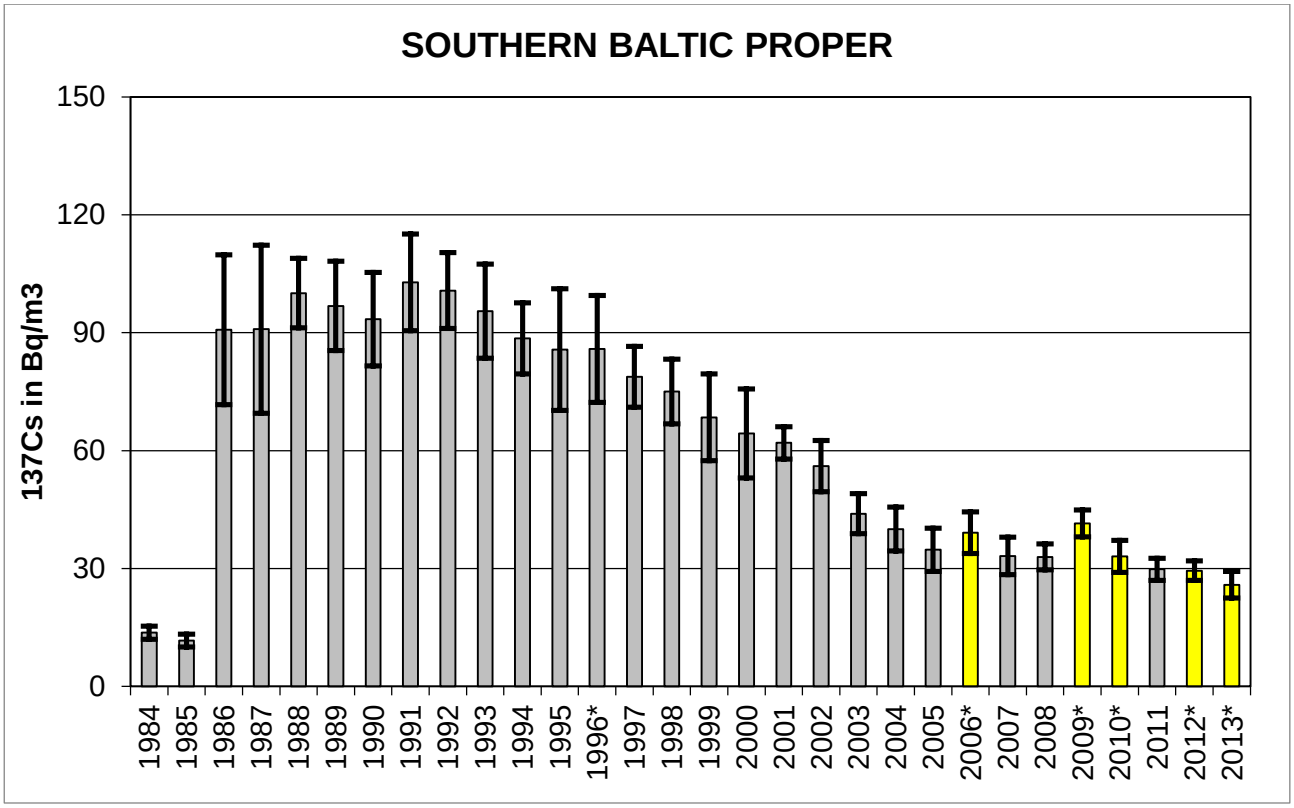


Figure 7i. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Southern Baltic Proper. Years containing values below limit of detection are indicated with asterisk (*) and yellow bar.

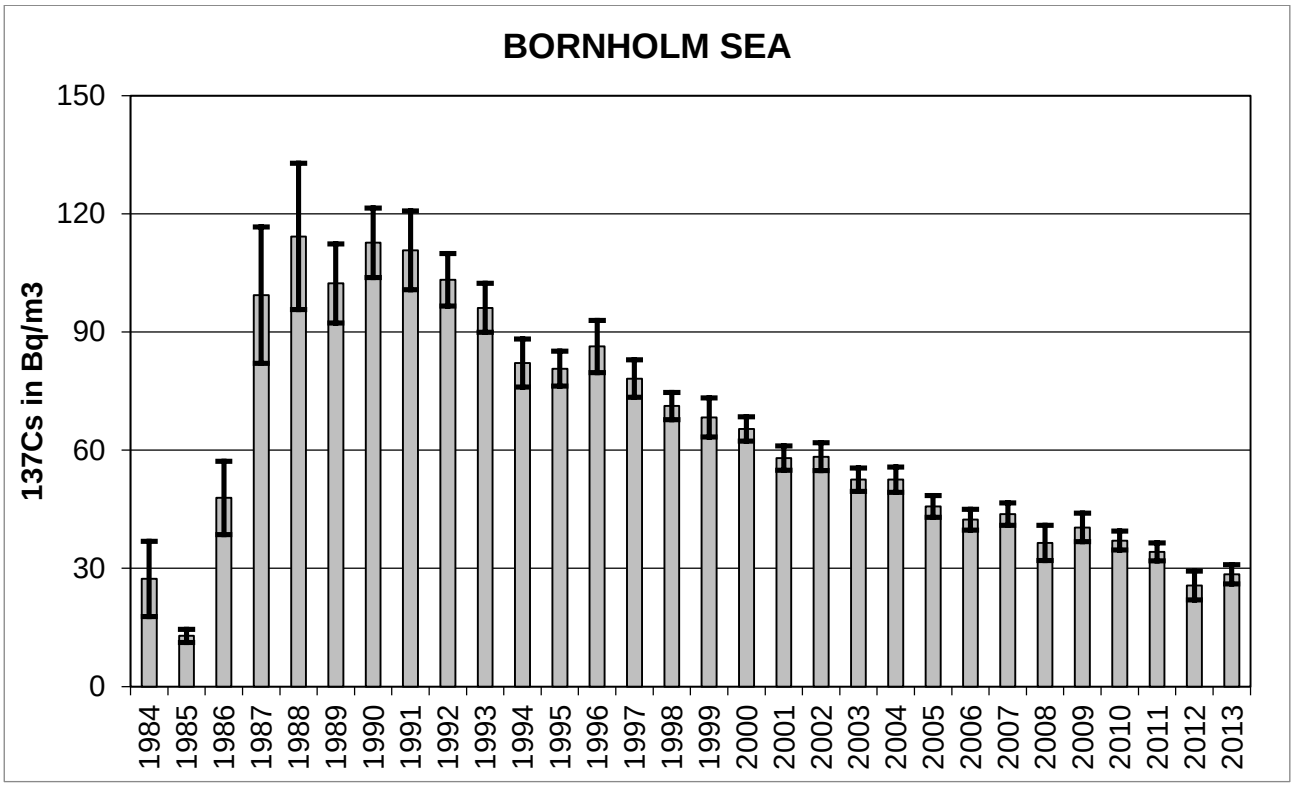


Figure 7j. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Bornholm Sea

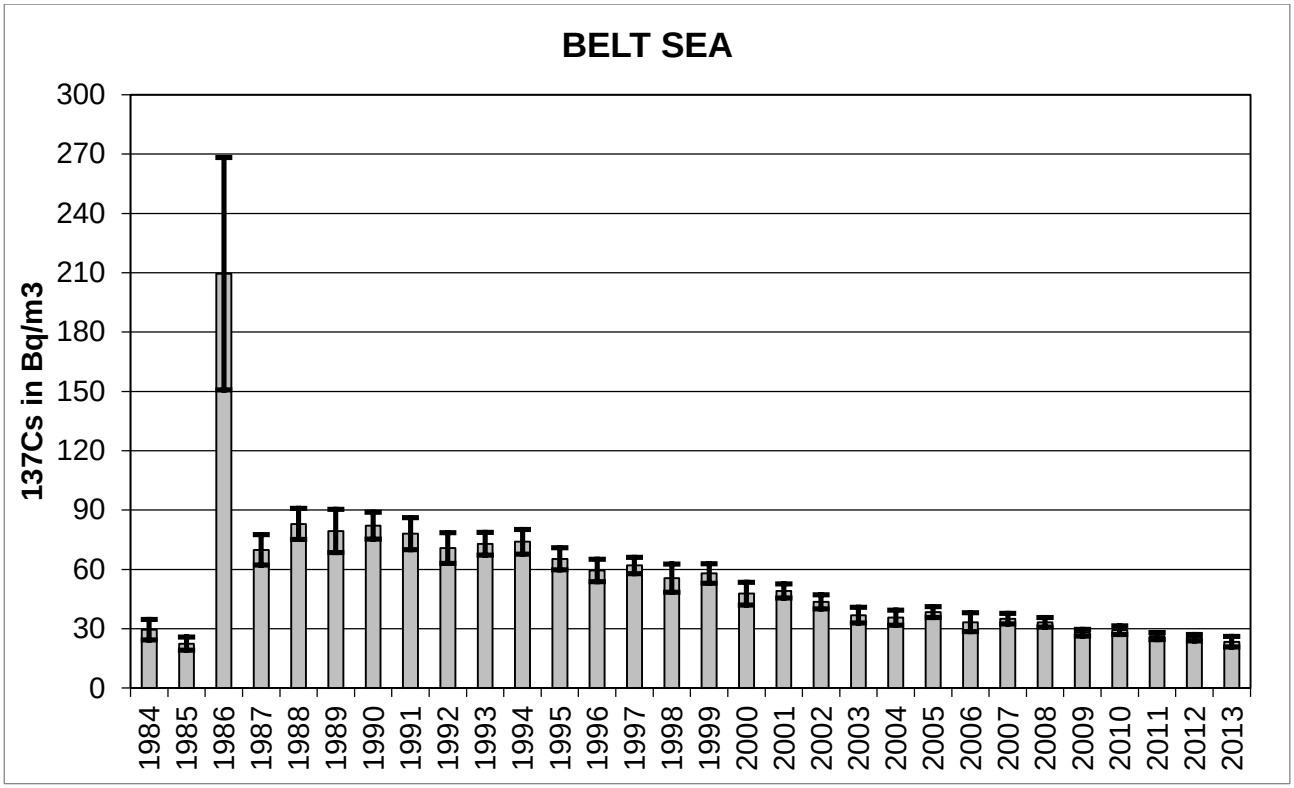


Figure 7k. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Belt Sea.

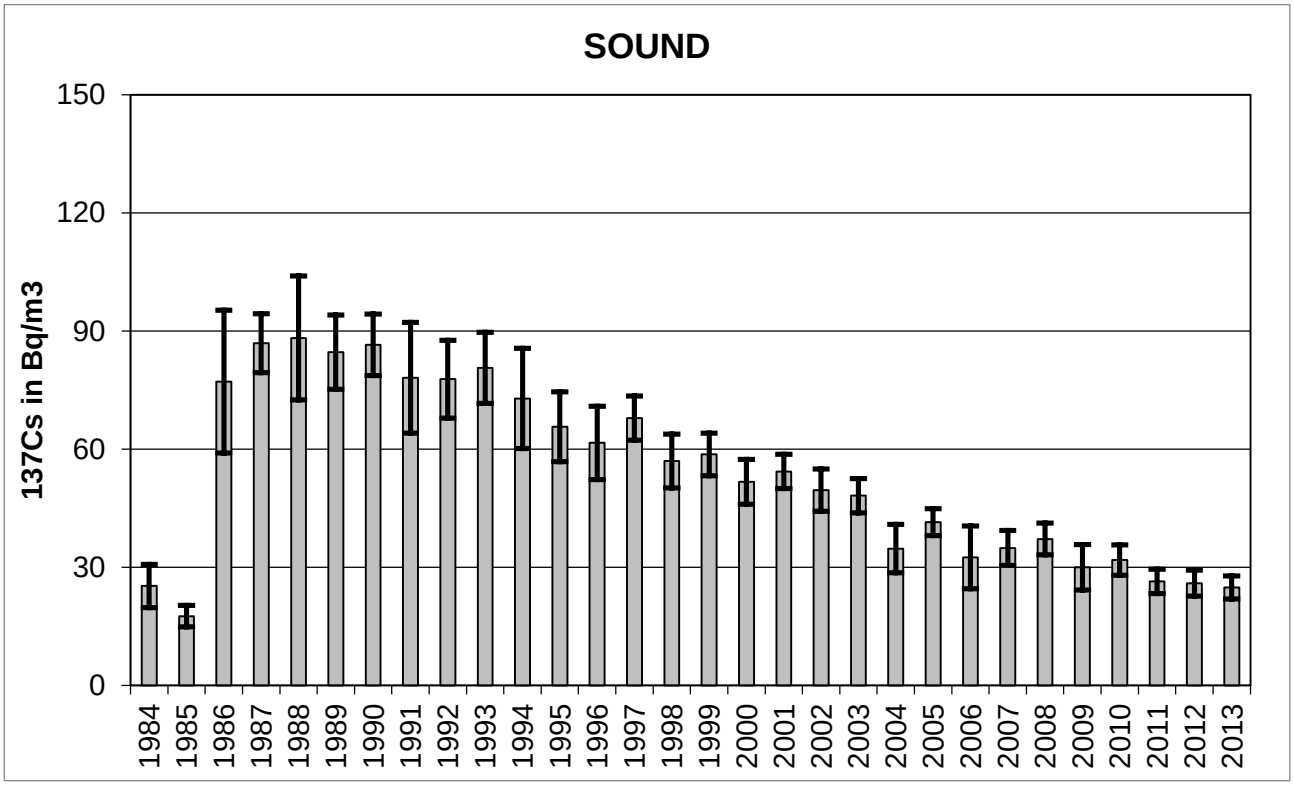


Figure 7l. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Sound.

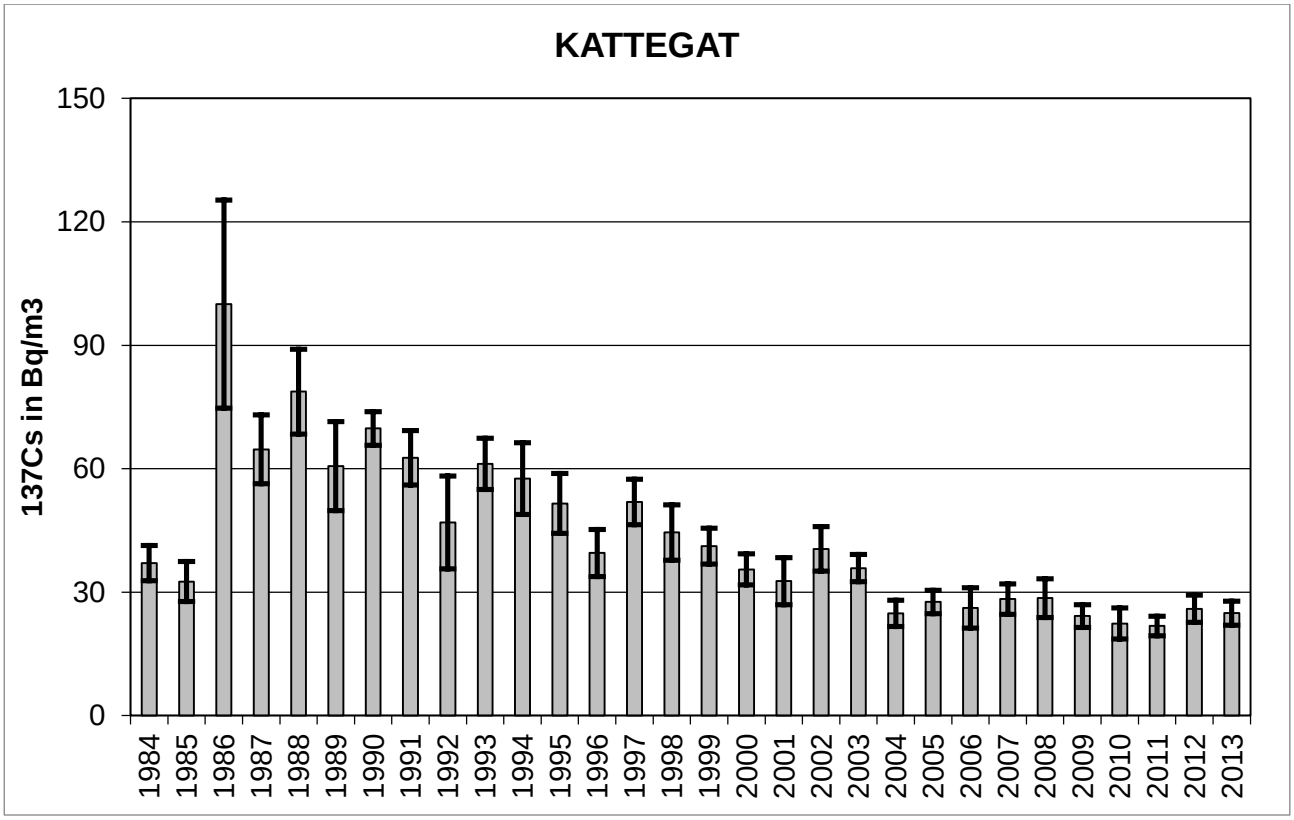


Figure 7m. ^{137}Cs (Bq/m^3) in surface water 1984-2013 in Kattegat.

SEAWATER SURFACE: Figures 8a-i. ^{90}Sr (Bq/m^3) in surface water 1984-2013

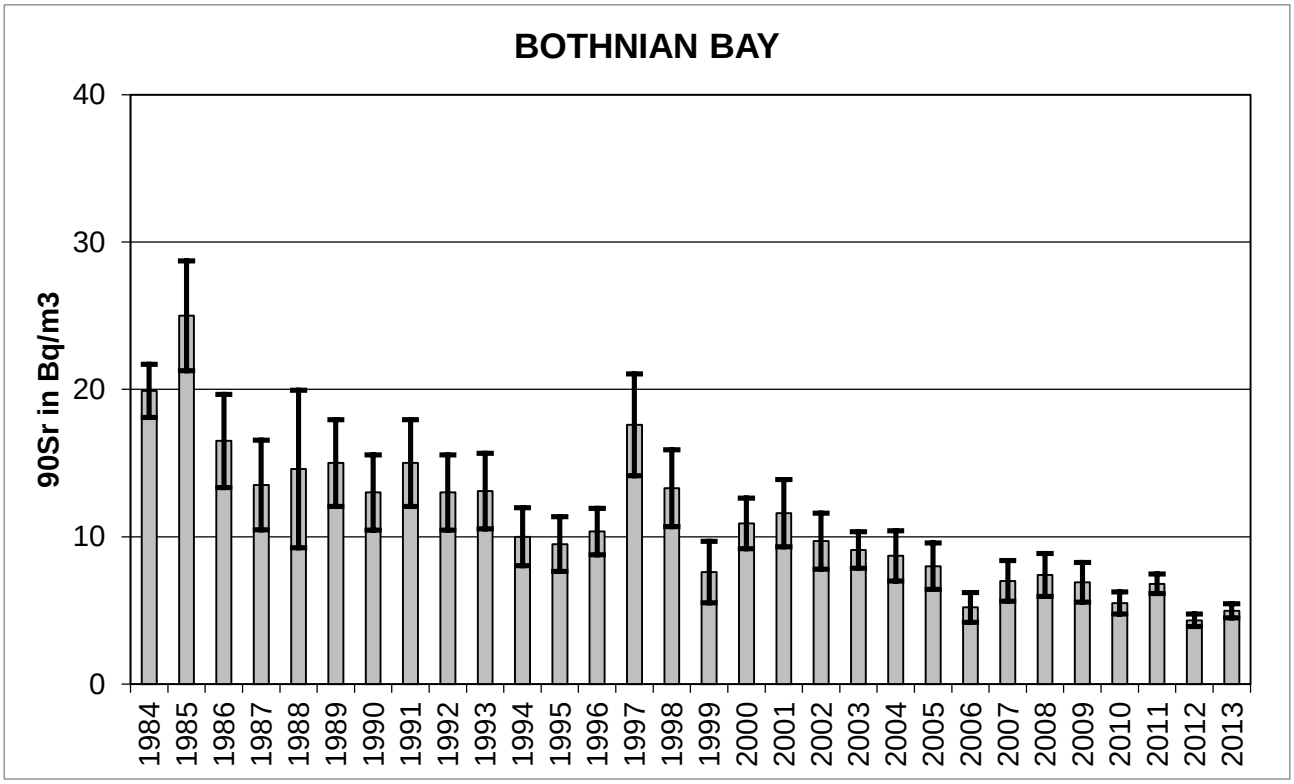


Figure 8a. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Bothnian Bay.

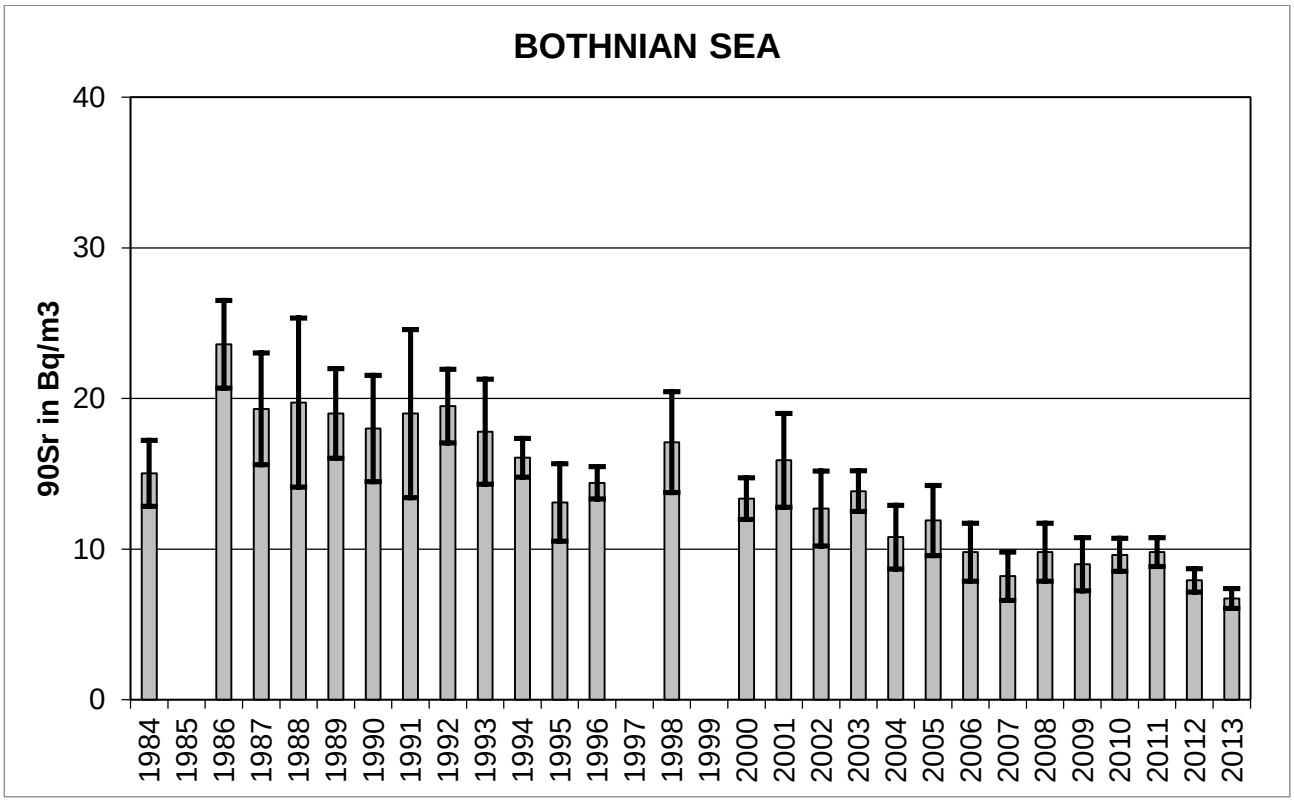


Figure 8b. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Bothnian Sea.

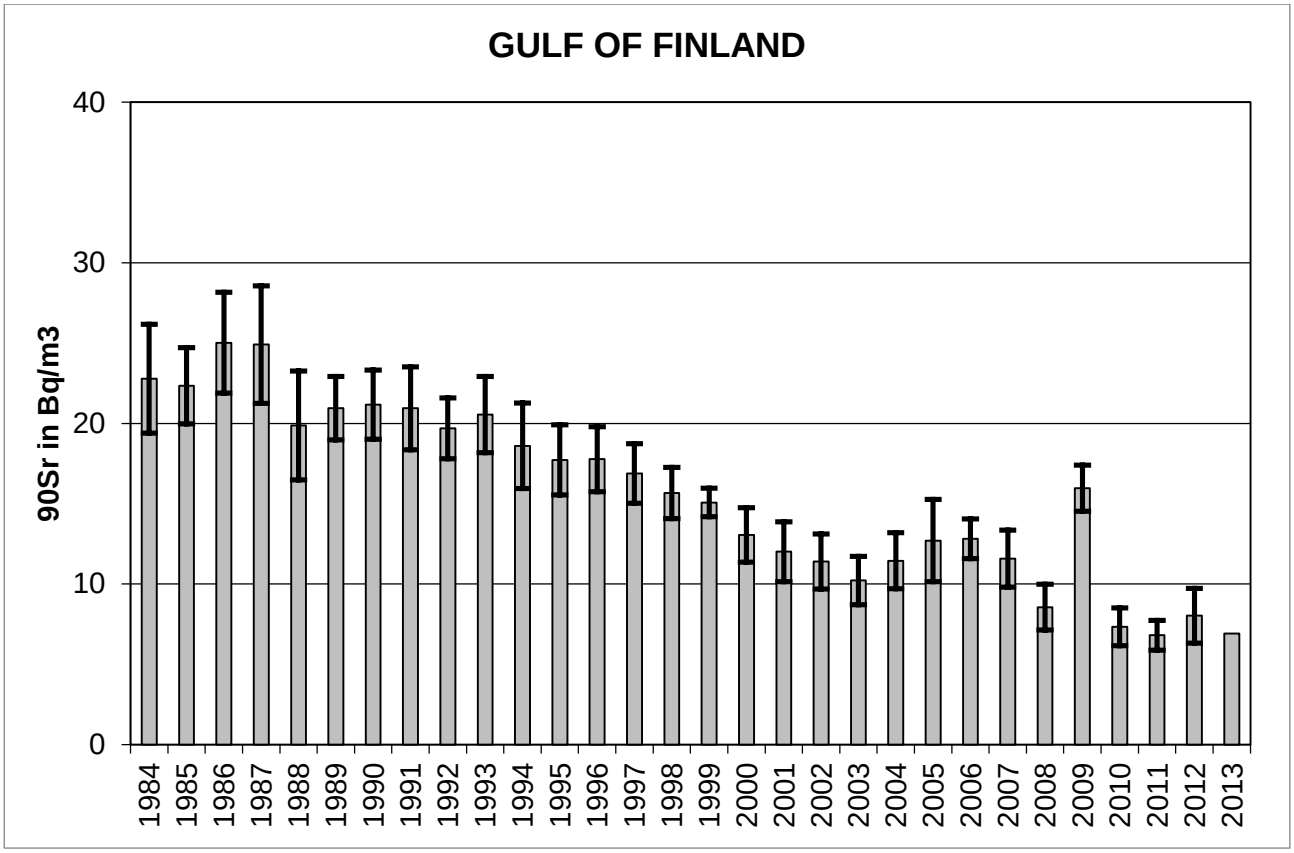


Figure 8c. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Gulf of Finland.

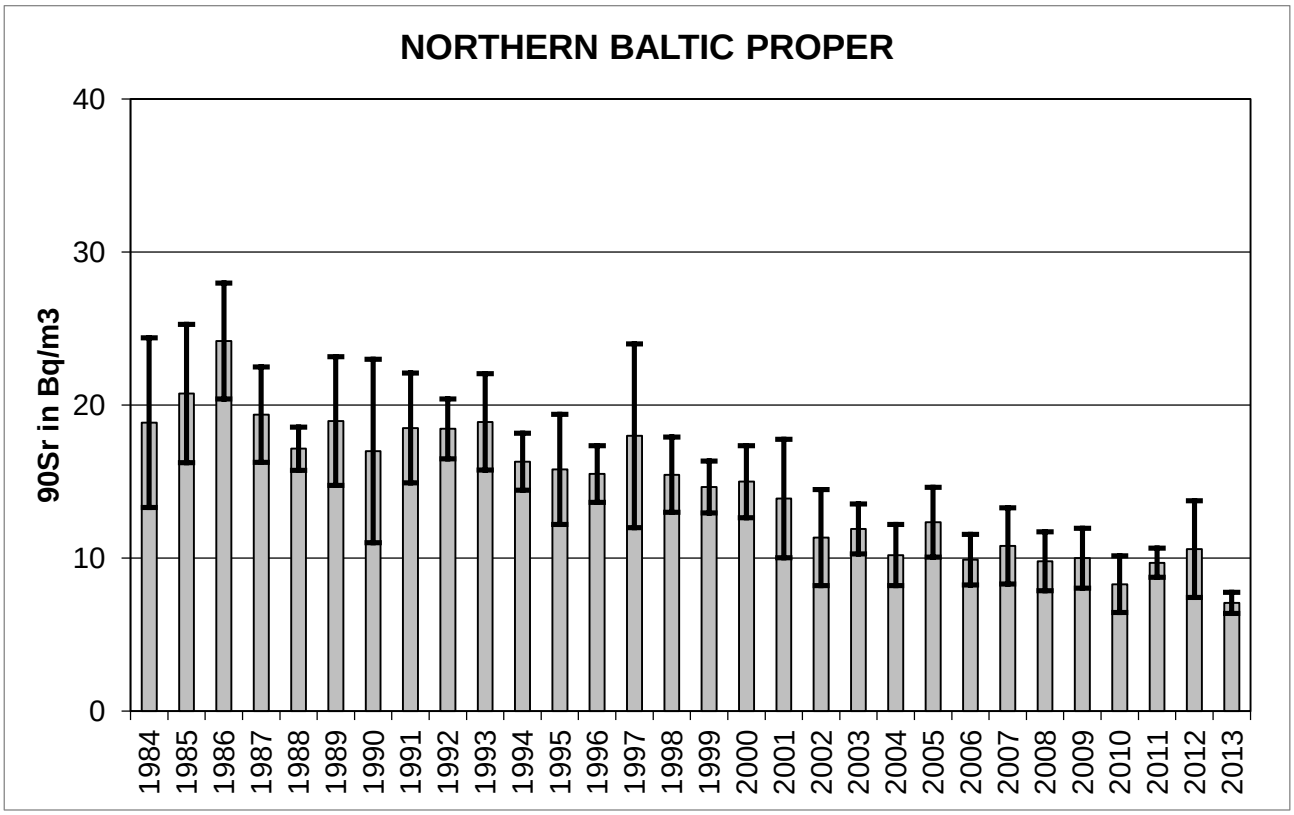


Figure 8d. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Northern Baltic Proper.

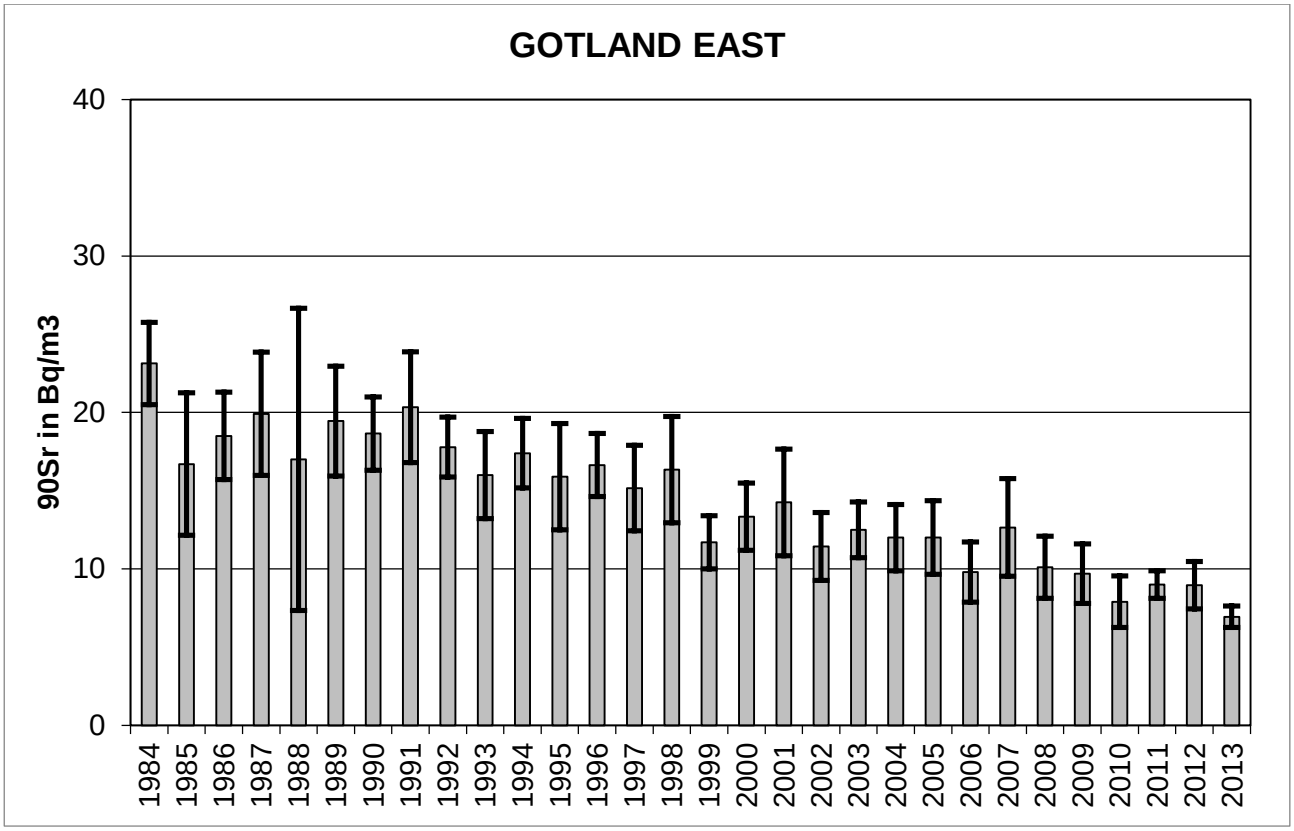


Figure 8e. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Gotland East.

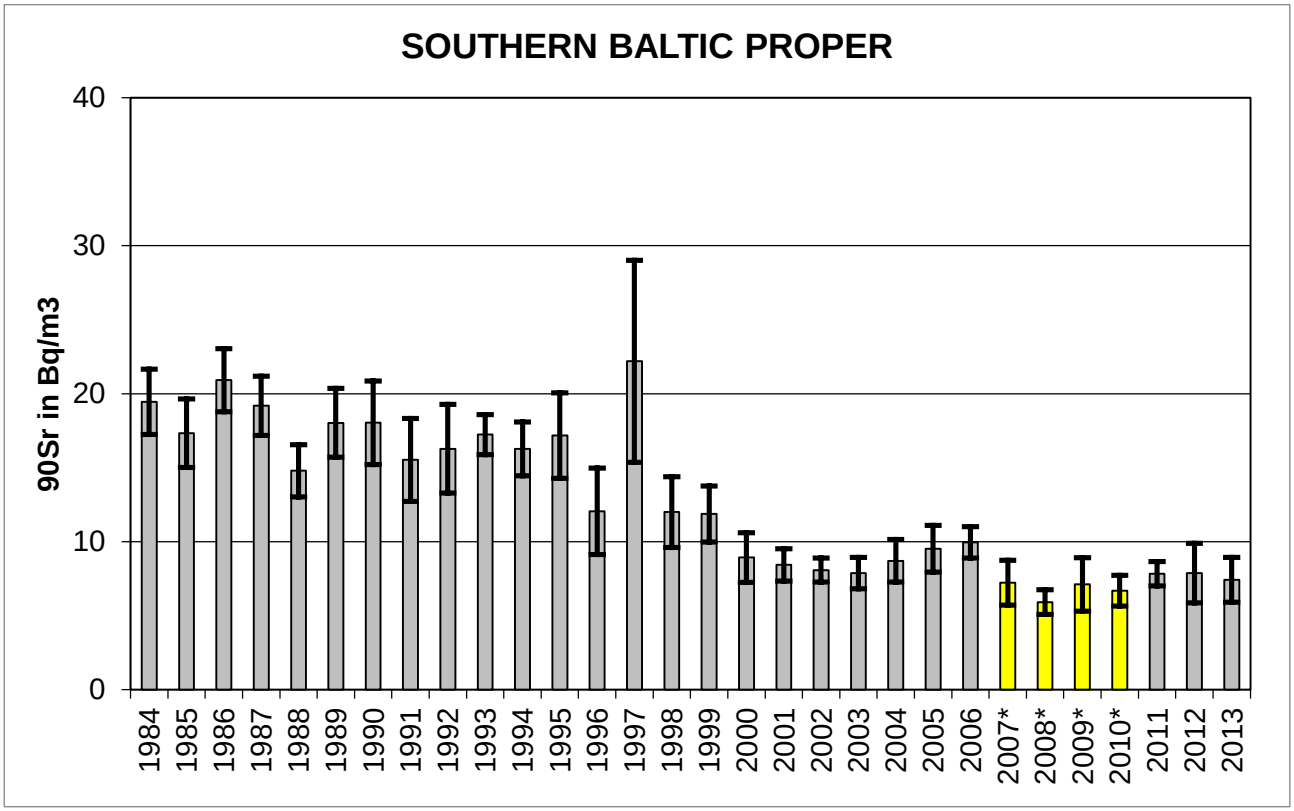


Figure 8f. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Southern Baltic Proper. Years containing values below limit of detection are indicated with asterisk (*) and yellow bar.

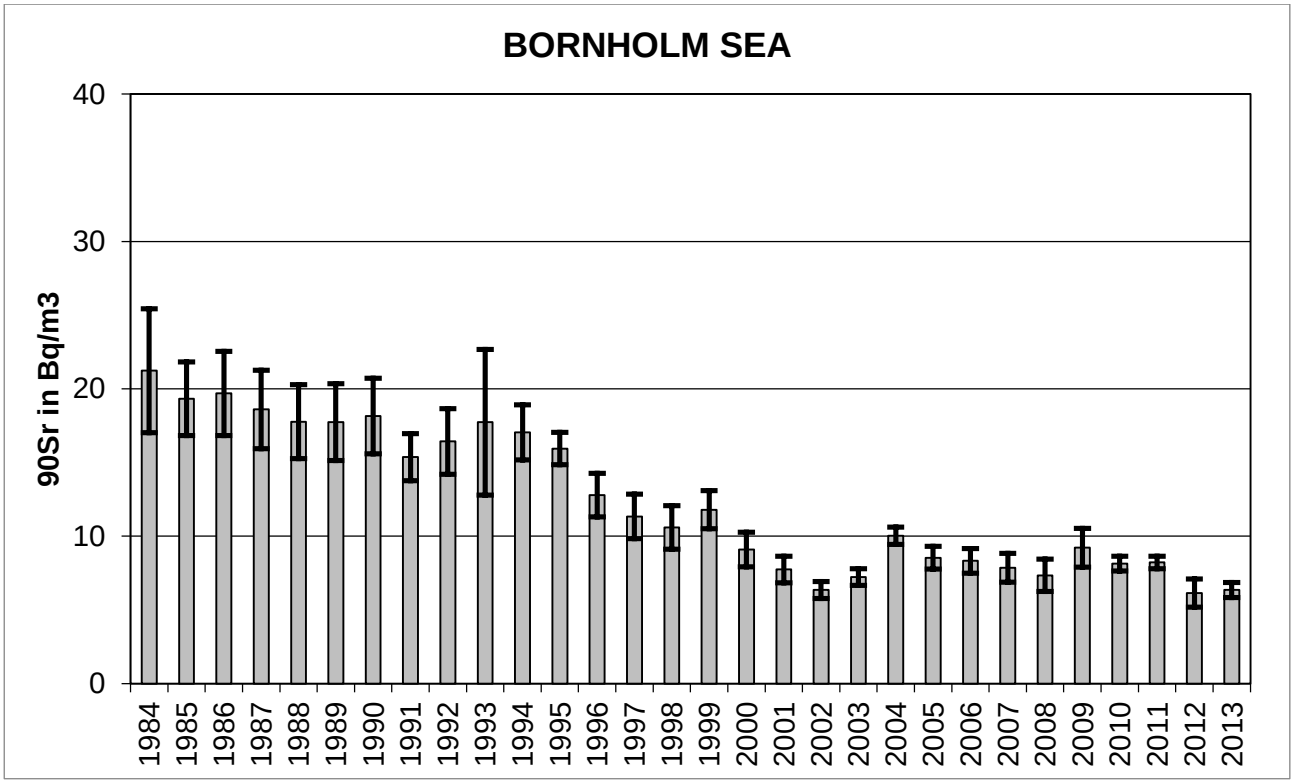


Figure 8g. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Bornholm Sea.

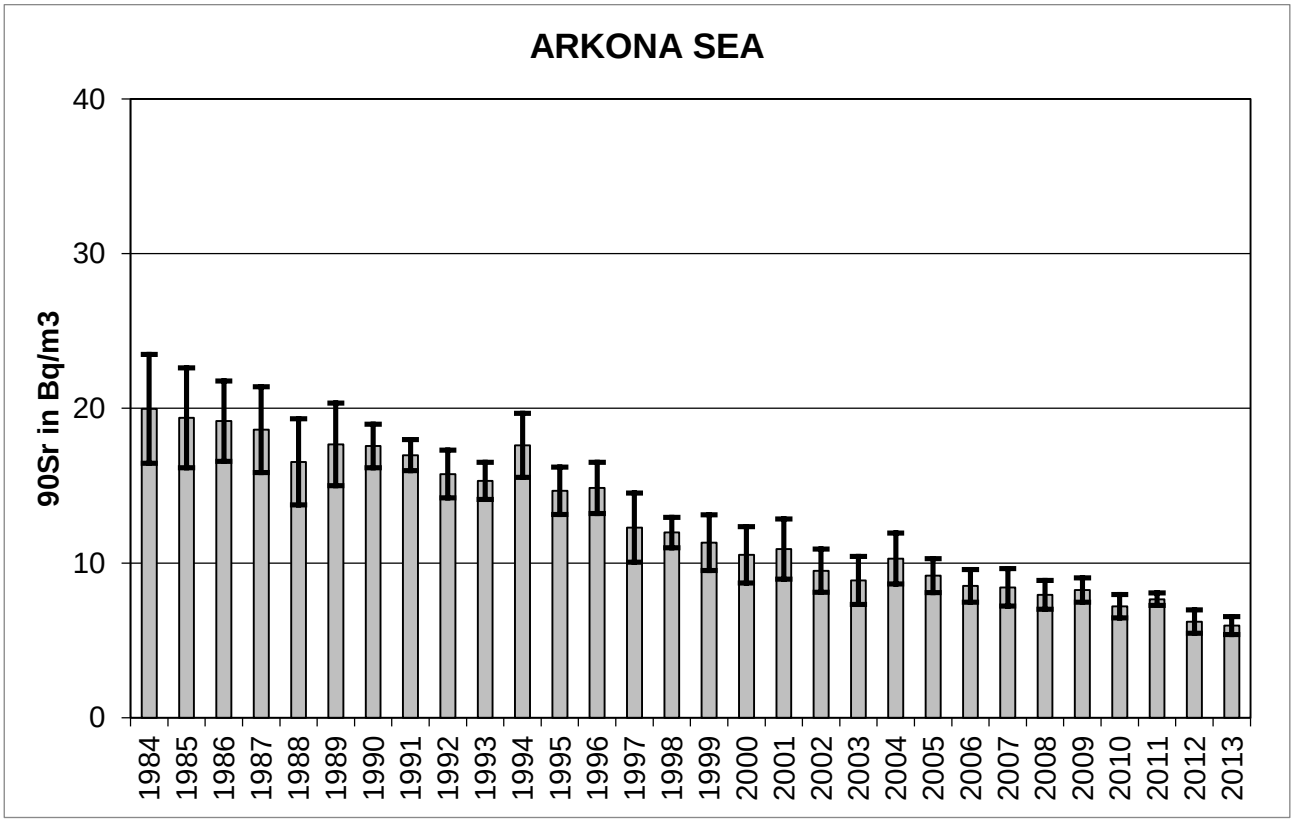


Figure 8h. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Arkona Sea.

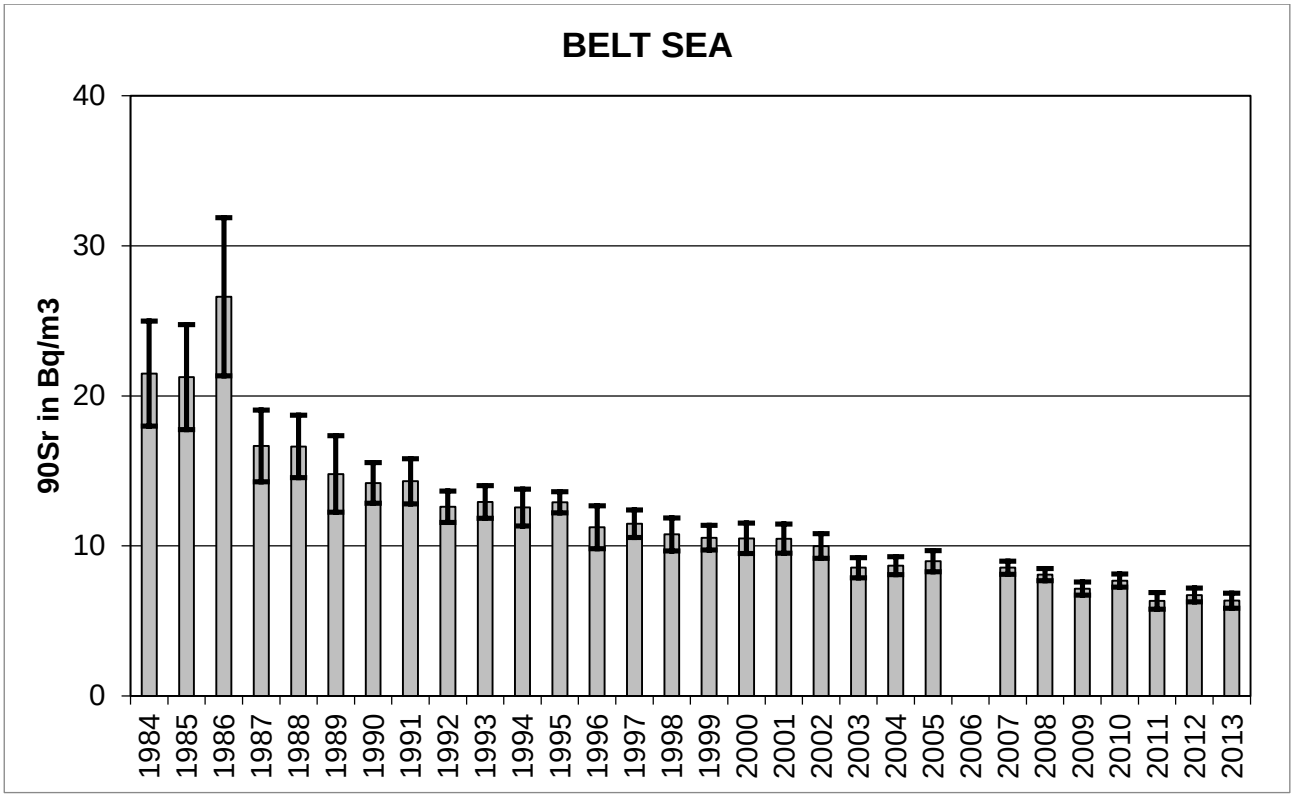


Figure 8i. ^{90}Sr (Bq/m^3) in surface water 1984-2013 in Belt Sea.

SEAWATER BOTTOM: Figures 9a-k. ^{137}Cs (Bq/m^3) in bottom water 1984-2013

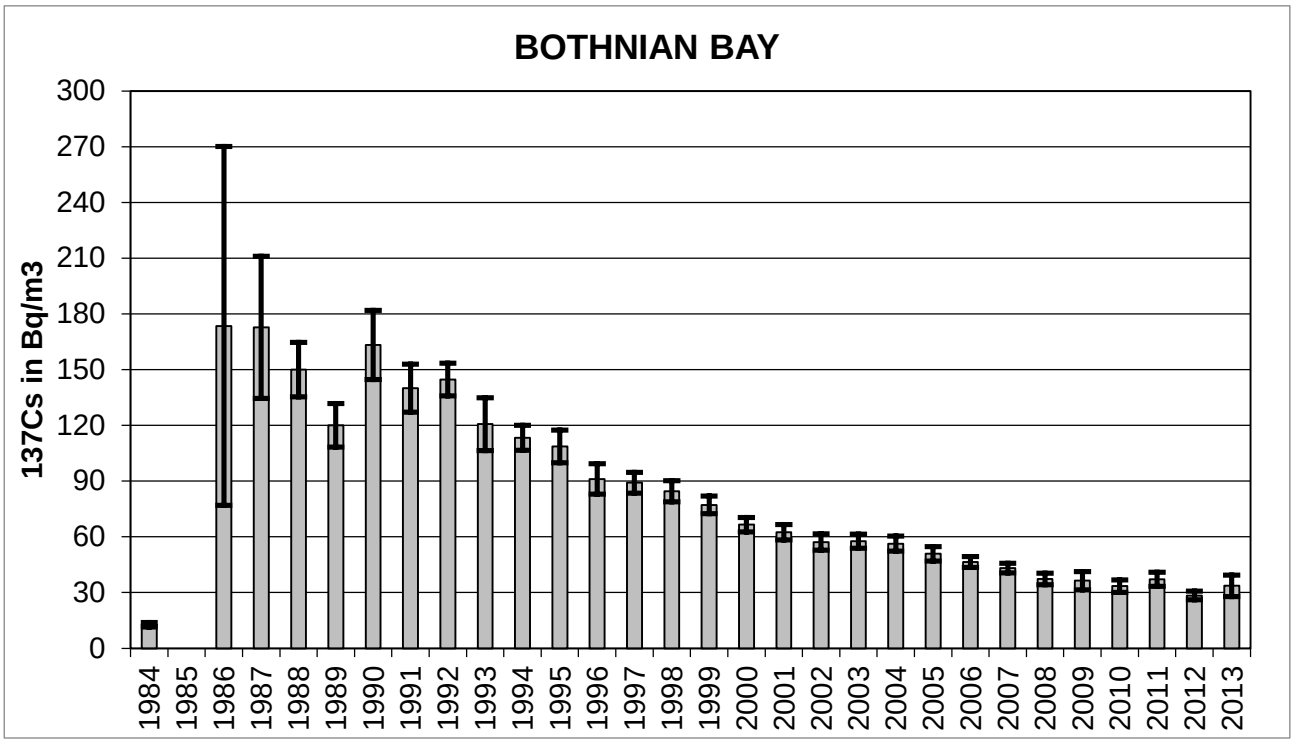


Figure 9a. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Bothnian Bay.

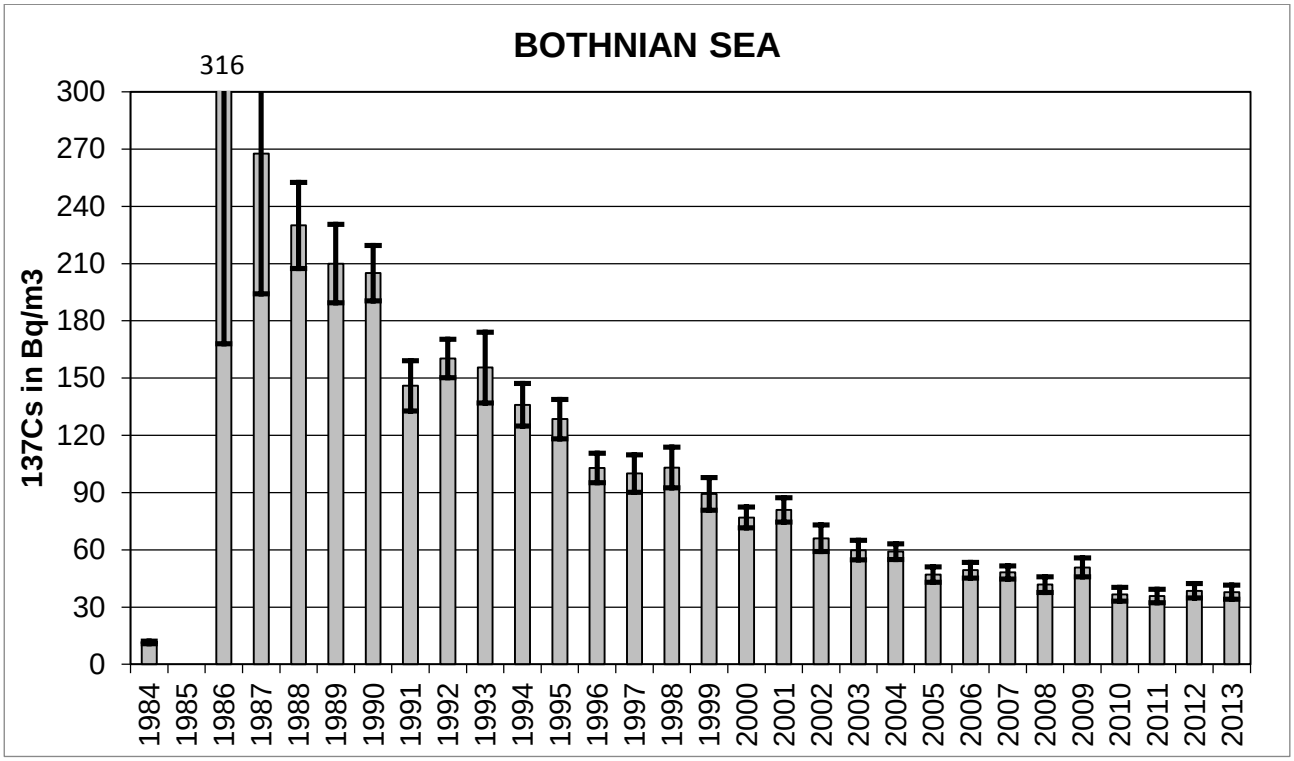


Figure 9b. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Bothnian Sea.

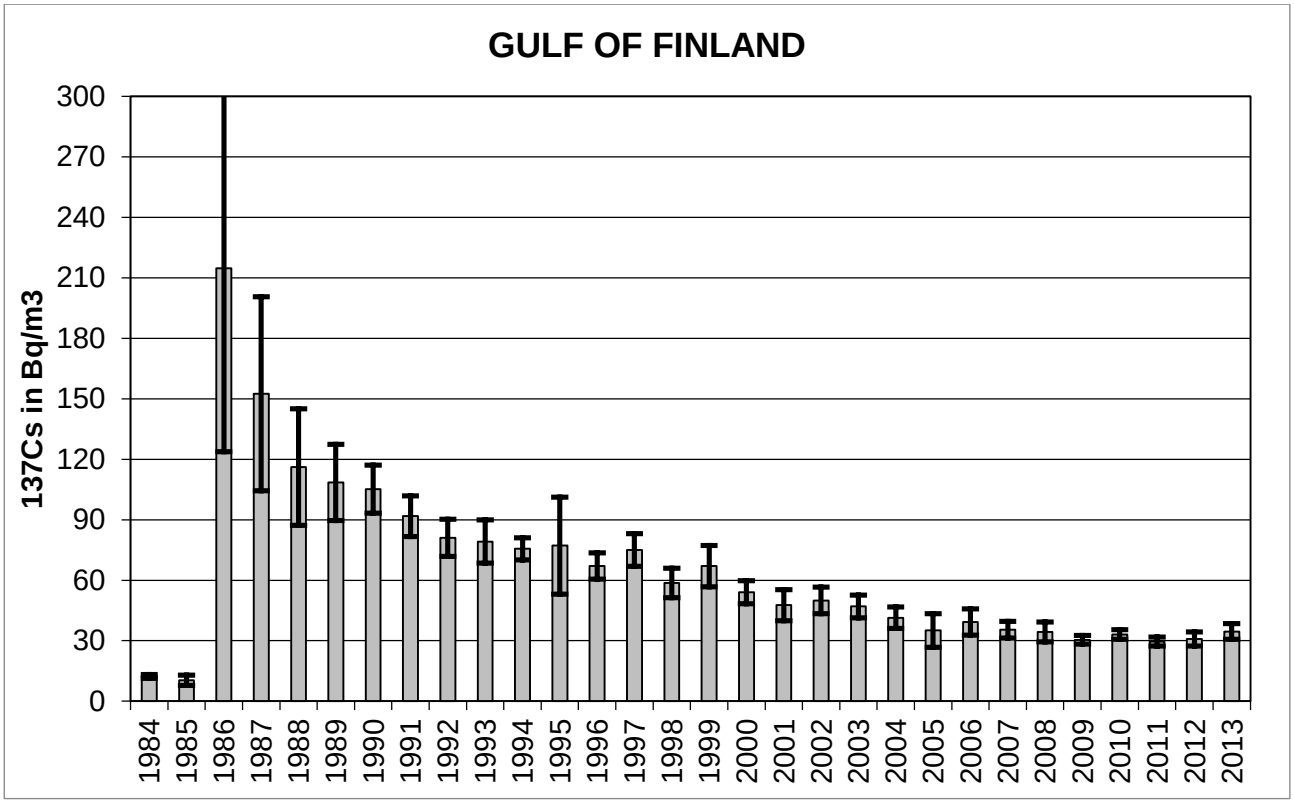


Figure 9c. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Gulf of Finland.

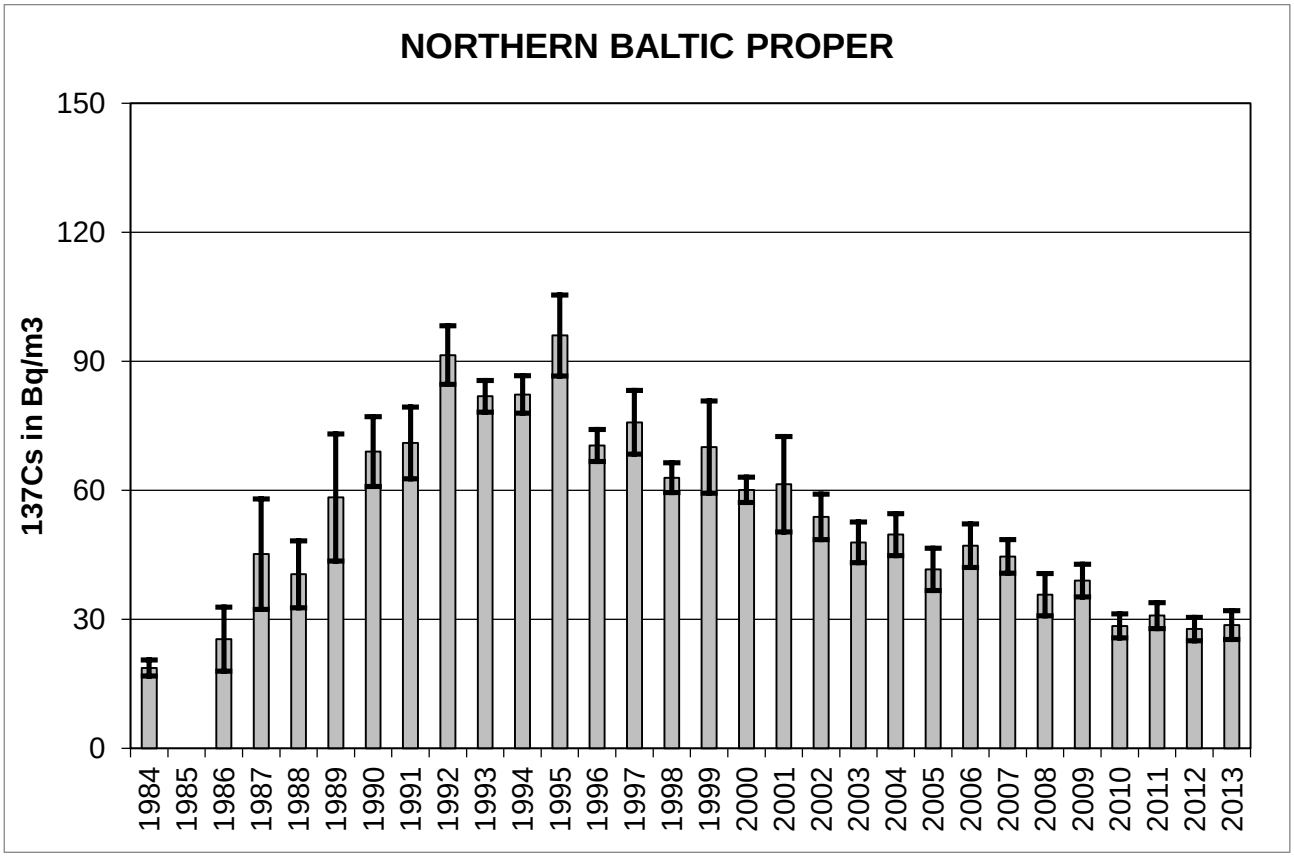


Figure 9d. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Northern Baltic Proper.

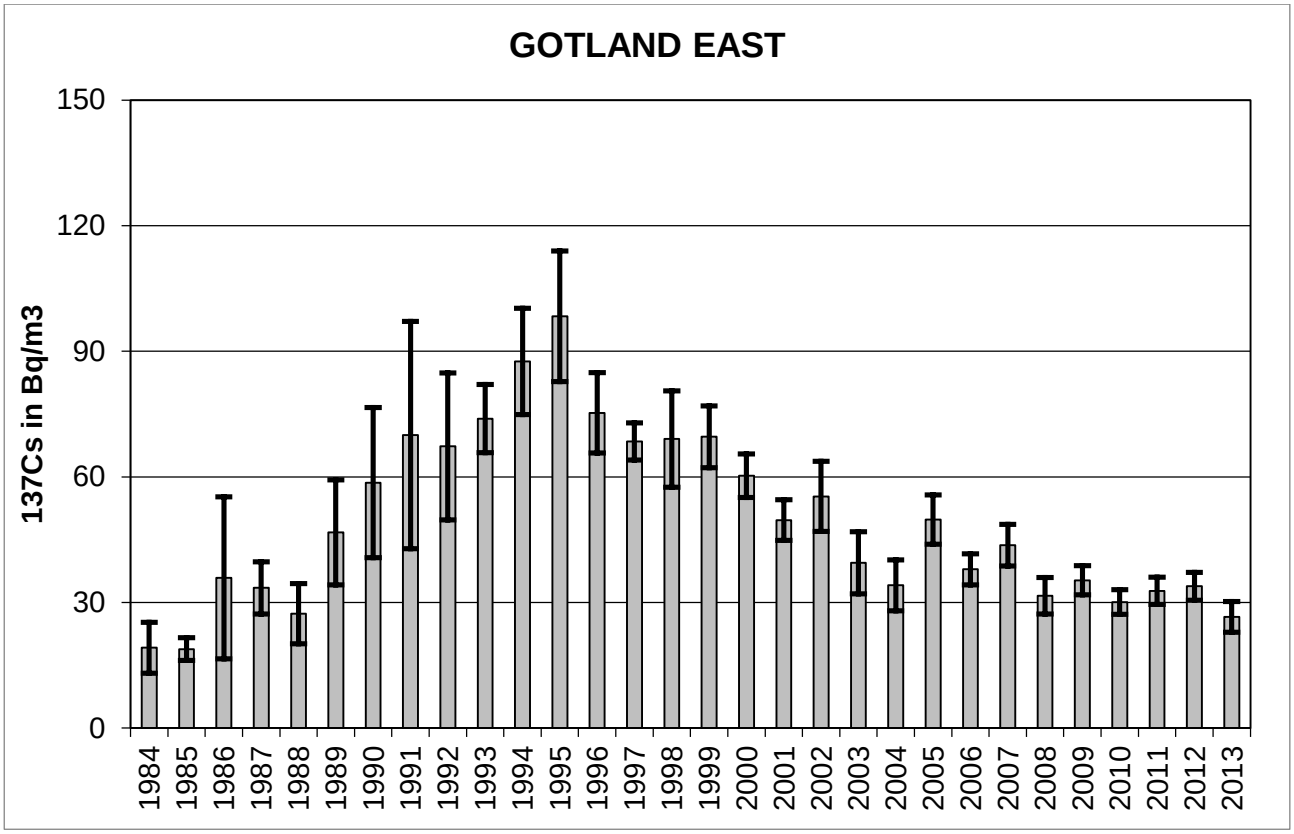


Figure 9e. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Gotland East.

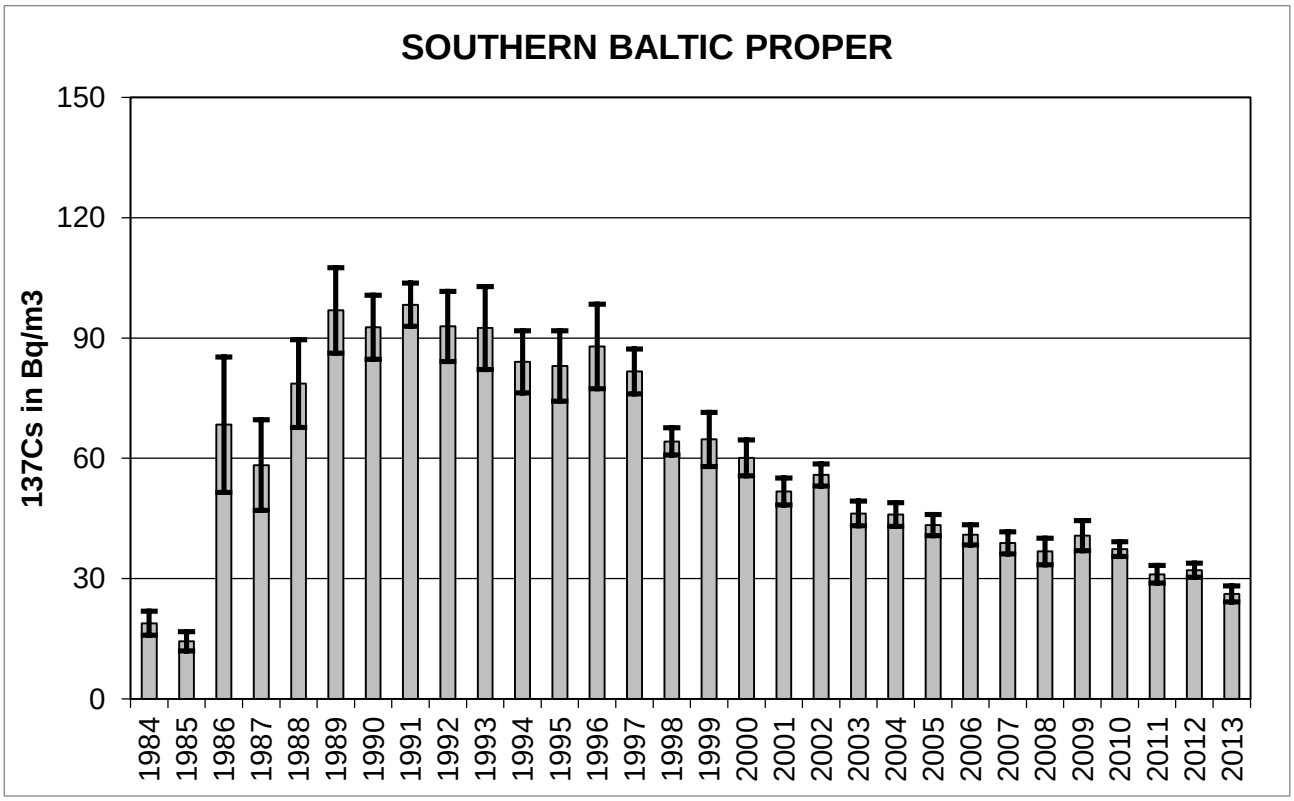


Figure 9f. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Southern Baltic Proper.

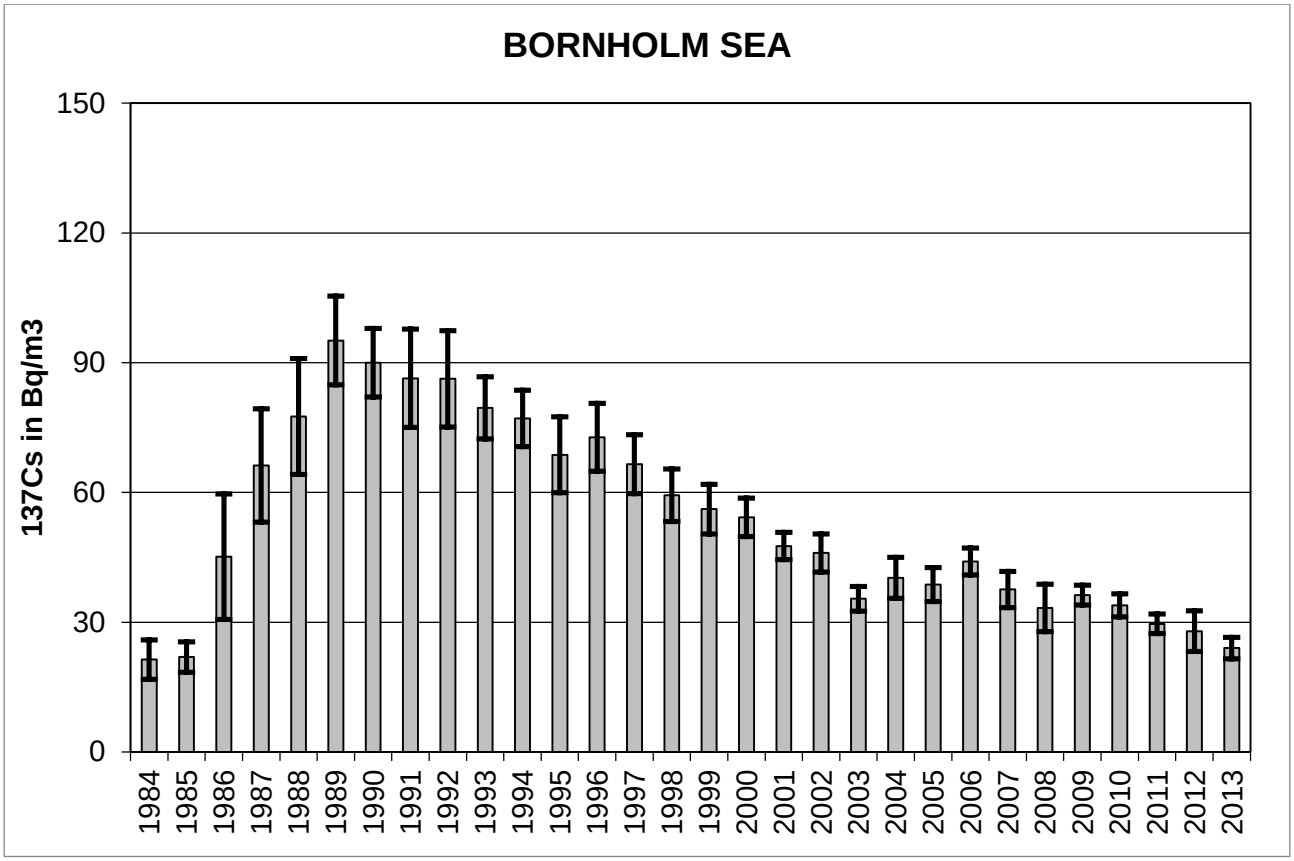


Figure 9g. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Bornholm Sea.

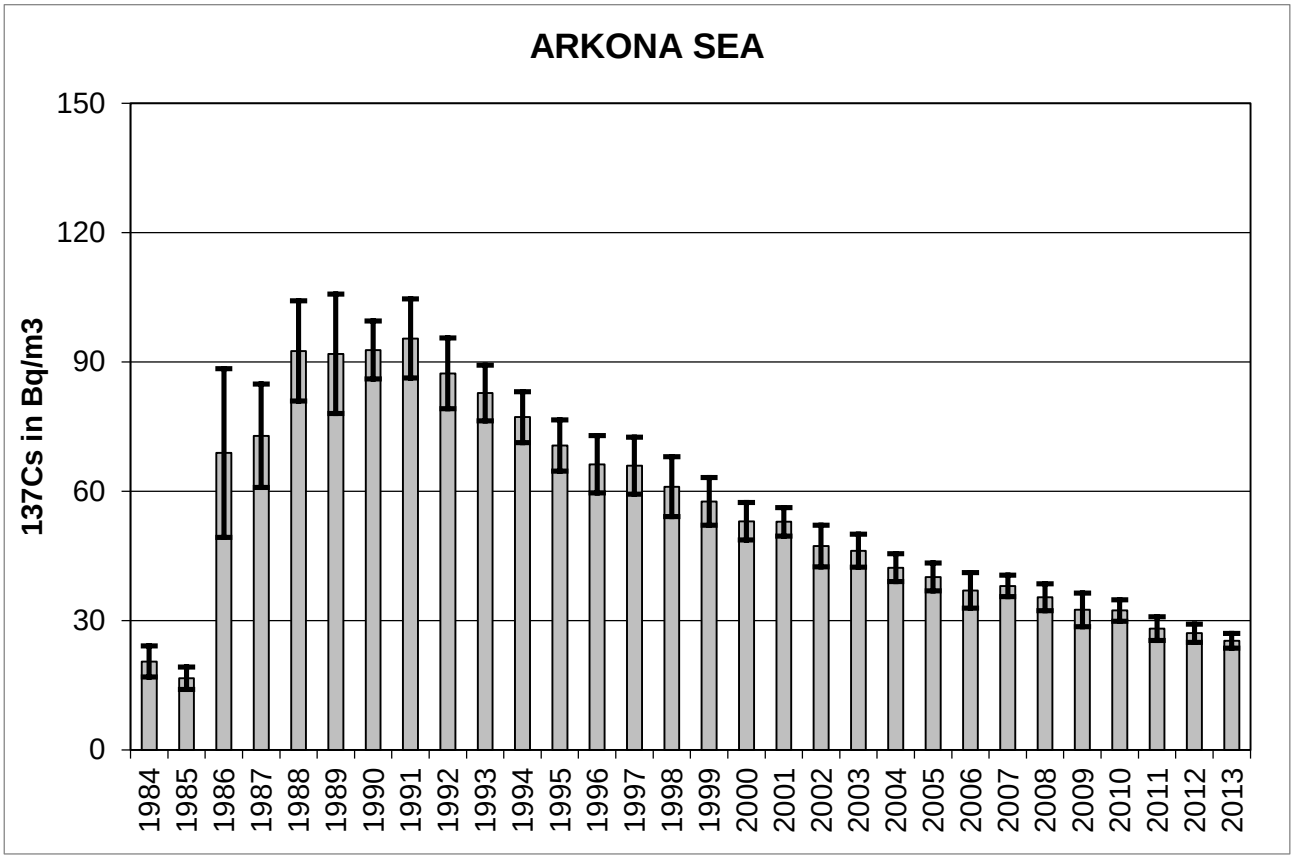


Figure 9h. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Arkona Sea.

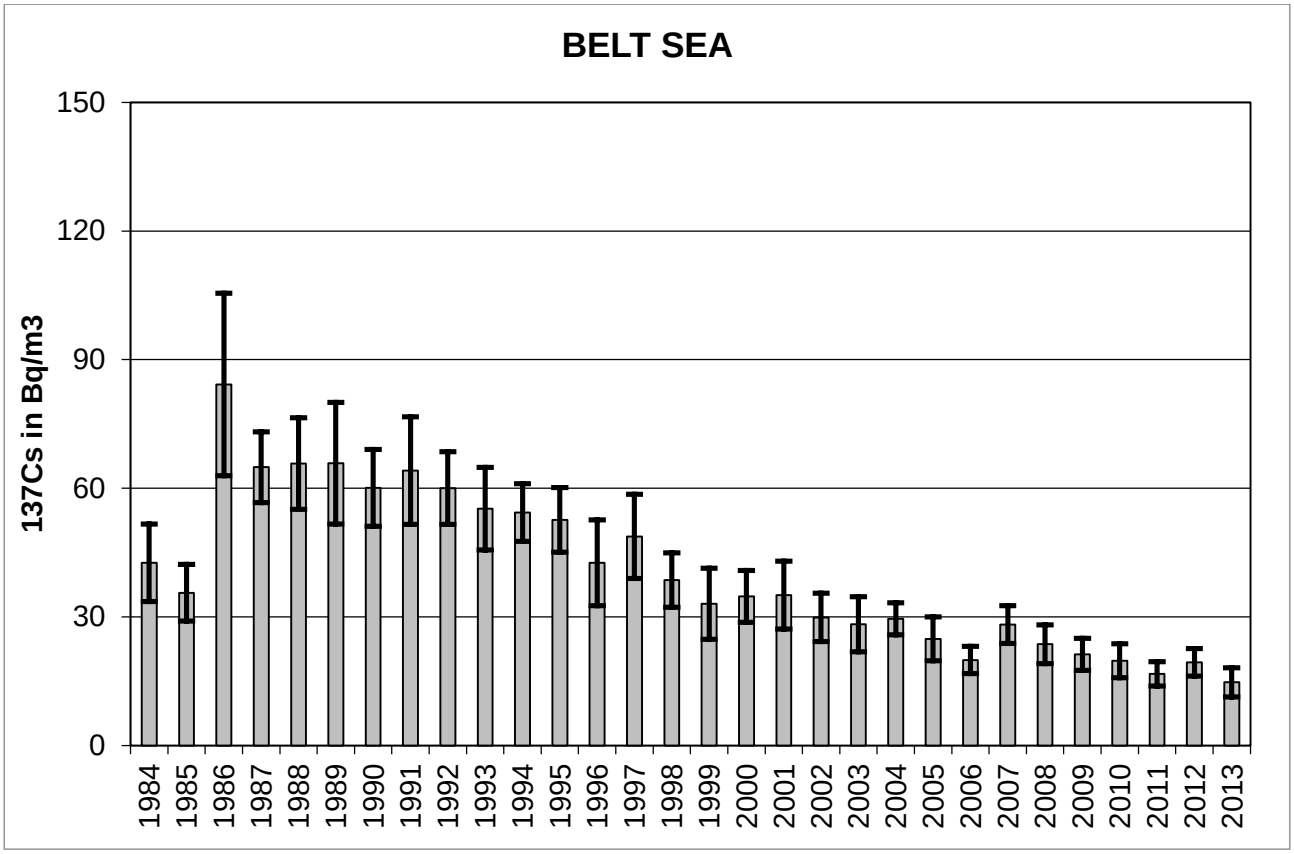


Figure 9i. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Belt Sea.

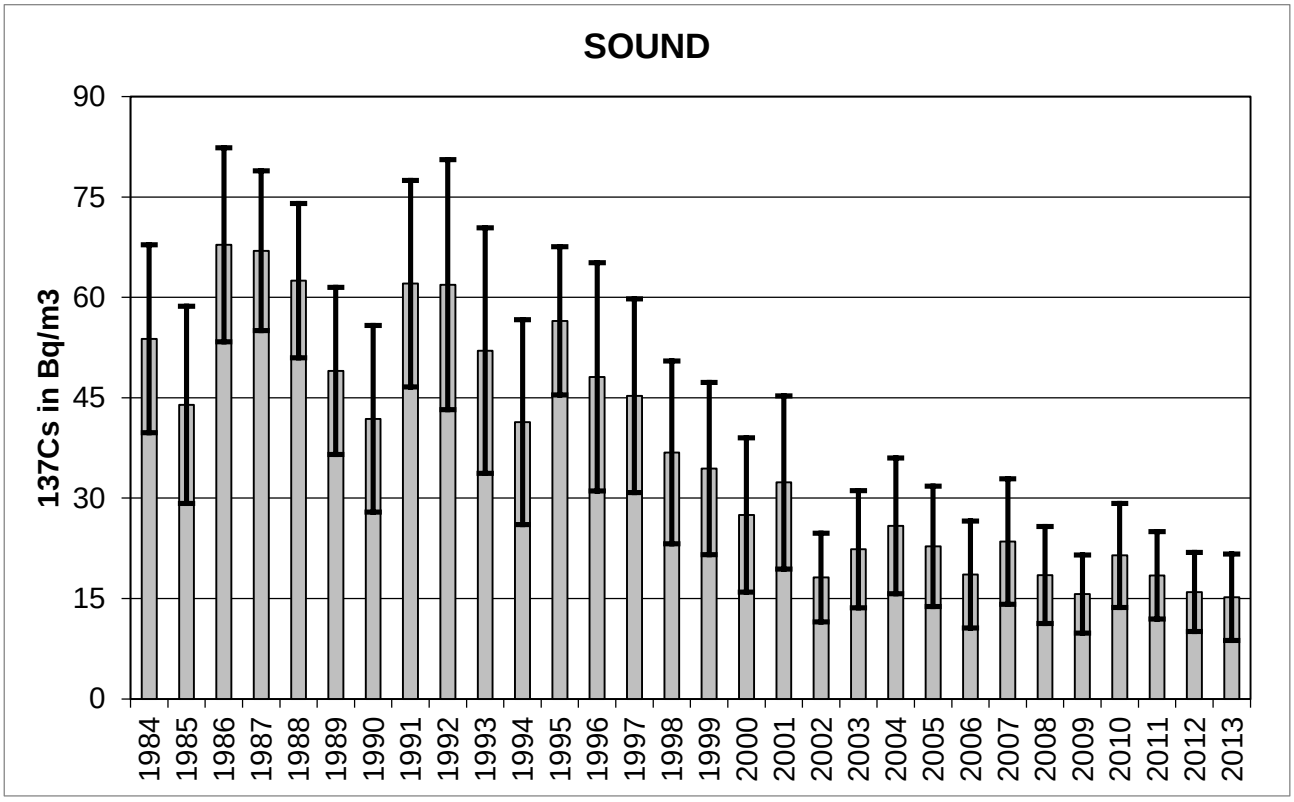


Figure 9j. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Sound.

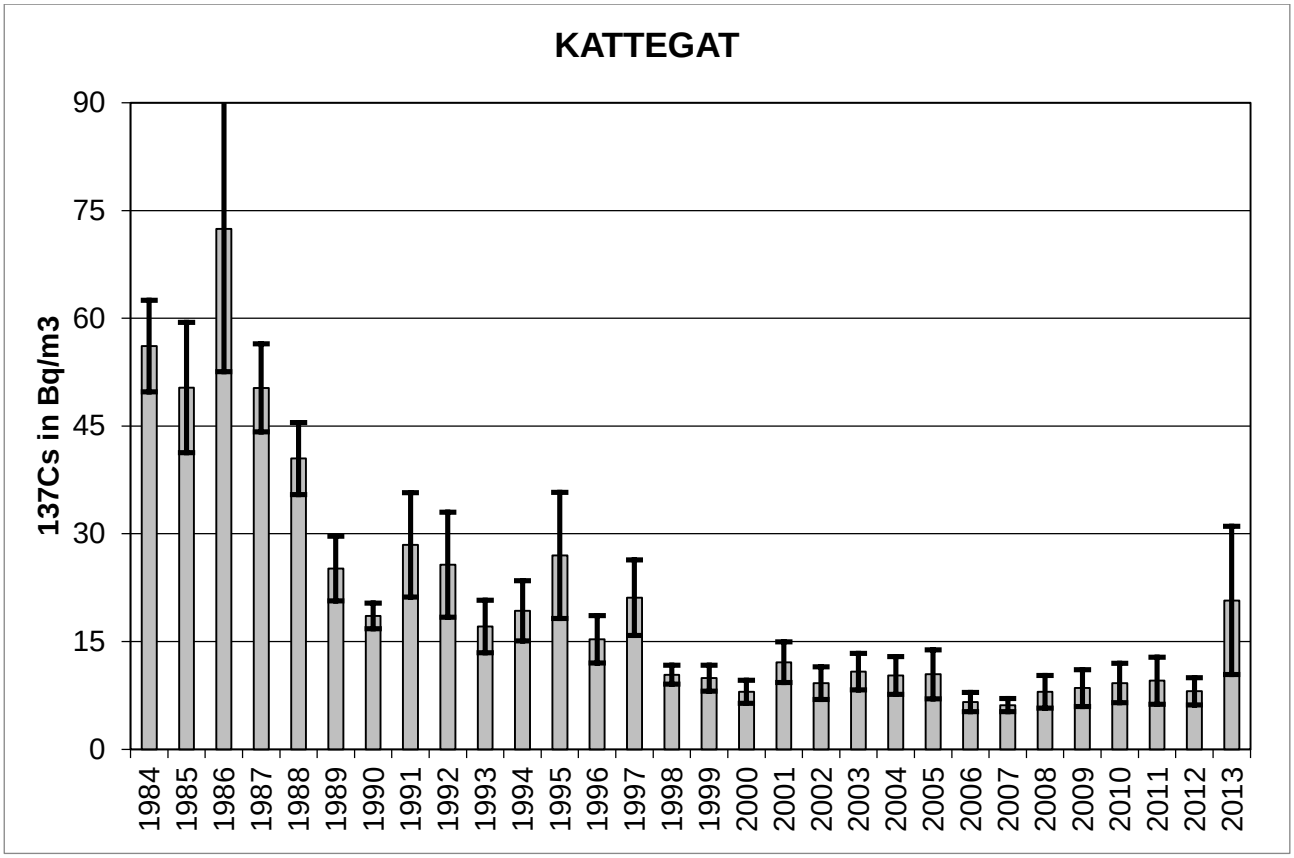


Figure 9k. ^{137}Cs (Bq/m^3) in bottom water 1984-2013 in Kattegat.

SEAWATER BOTTOM: Figures 10a-h. ^{90}Sr (Bq/m^3) in bottom water 1984-2013

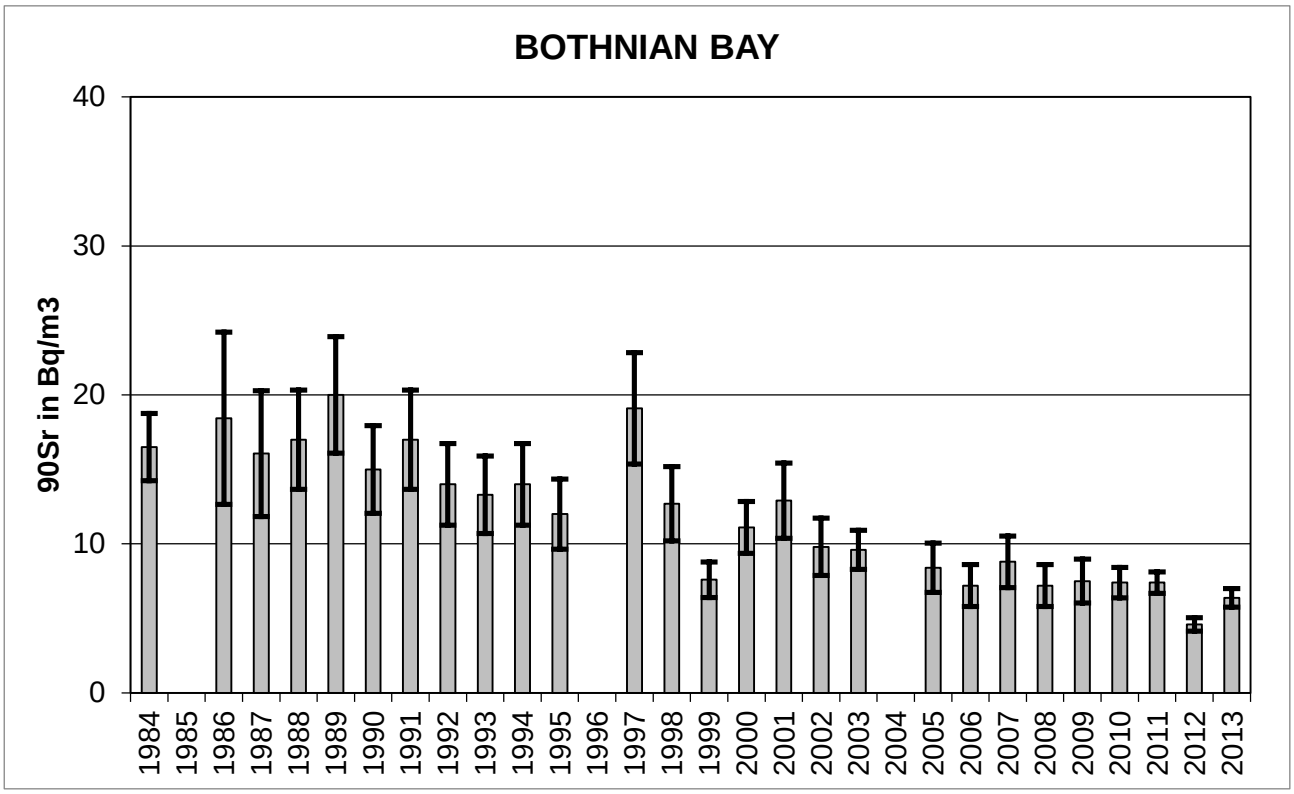


Figure 10a. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Bothnian Bay.

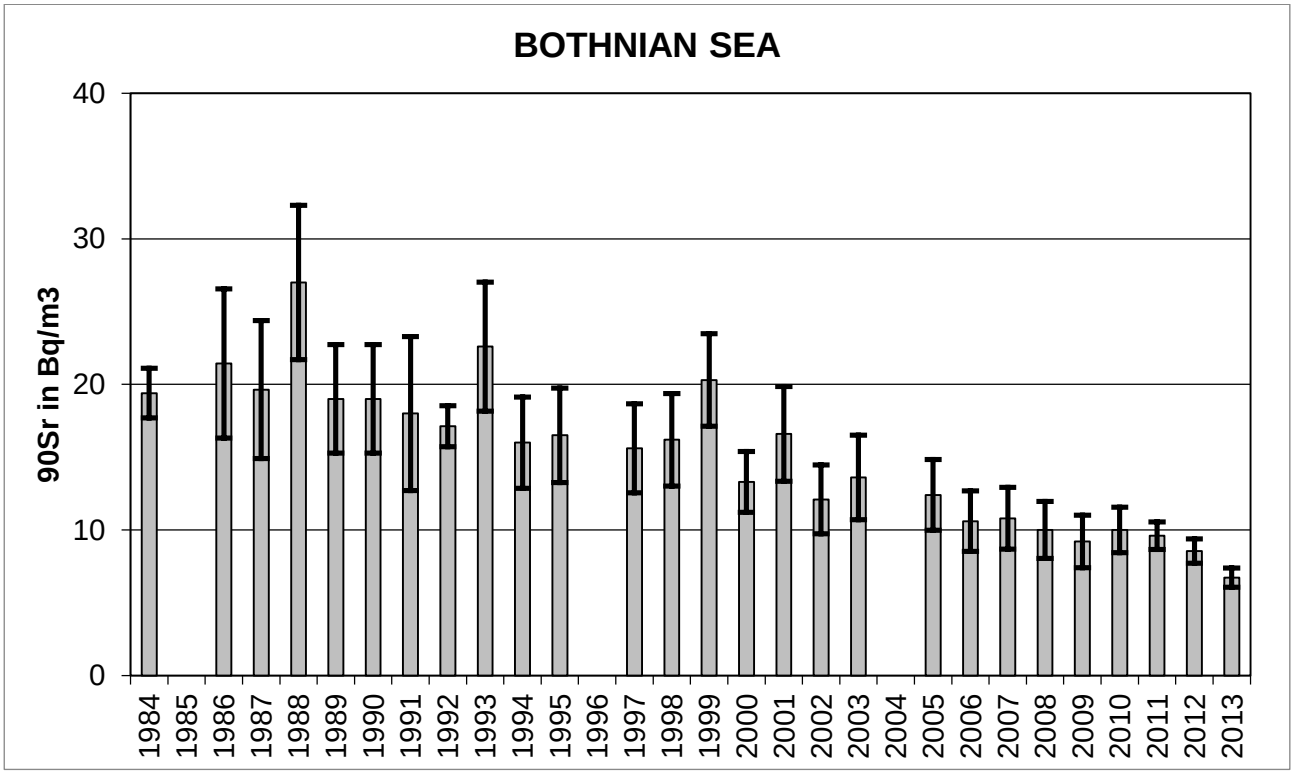


Figure 10b. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Bothnian Sea.

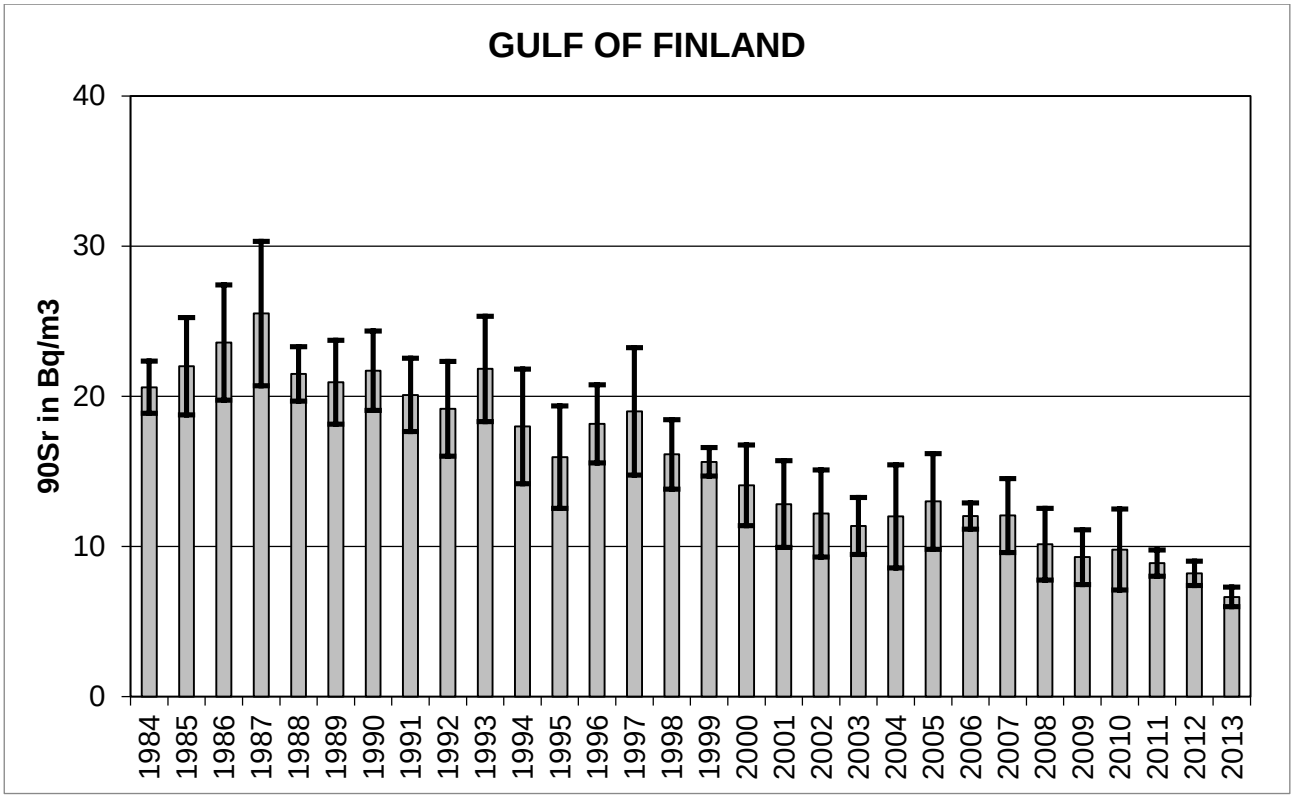


Figure 10c. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Gulf of Finland.

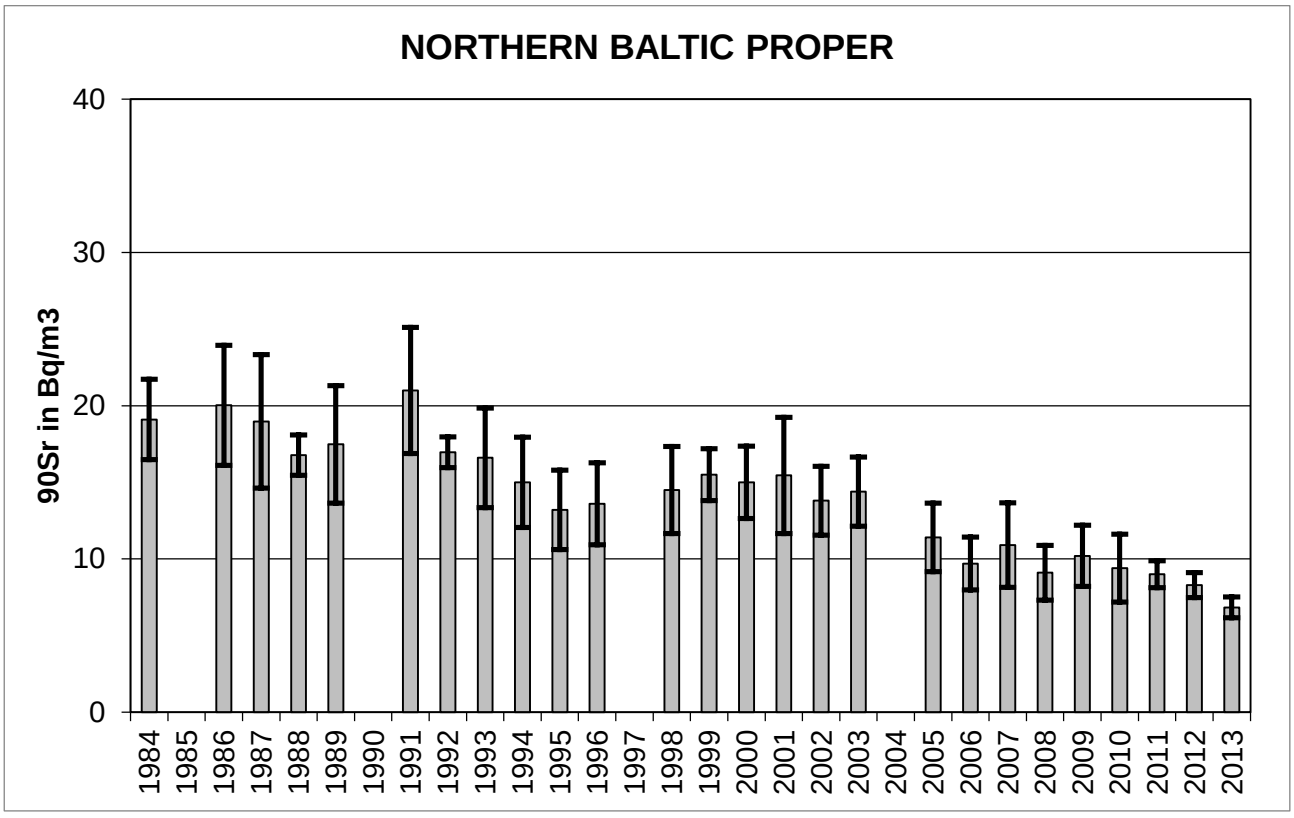


Figure 10d. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Gulf of Finland.

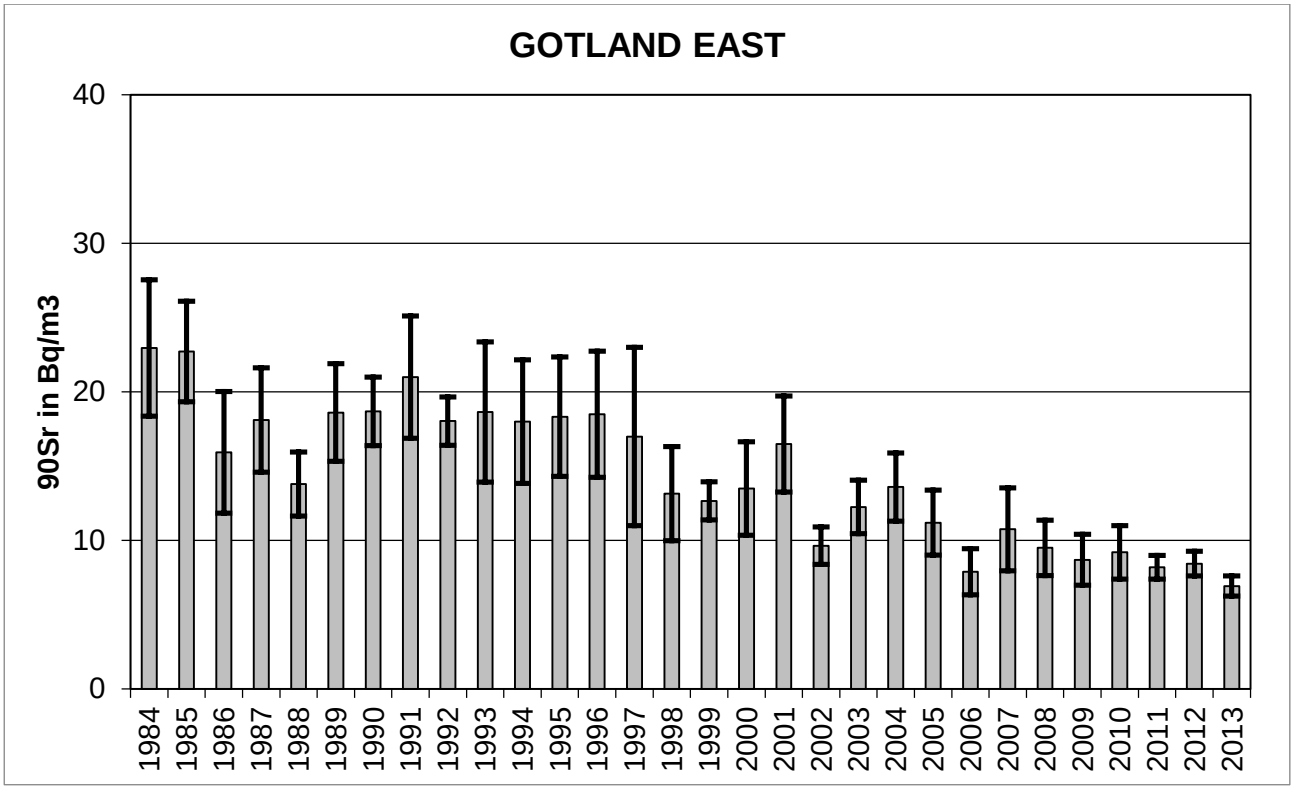


Figure 10e. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Gotland East.

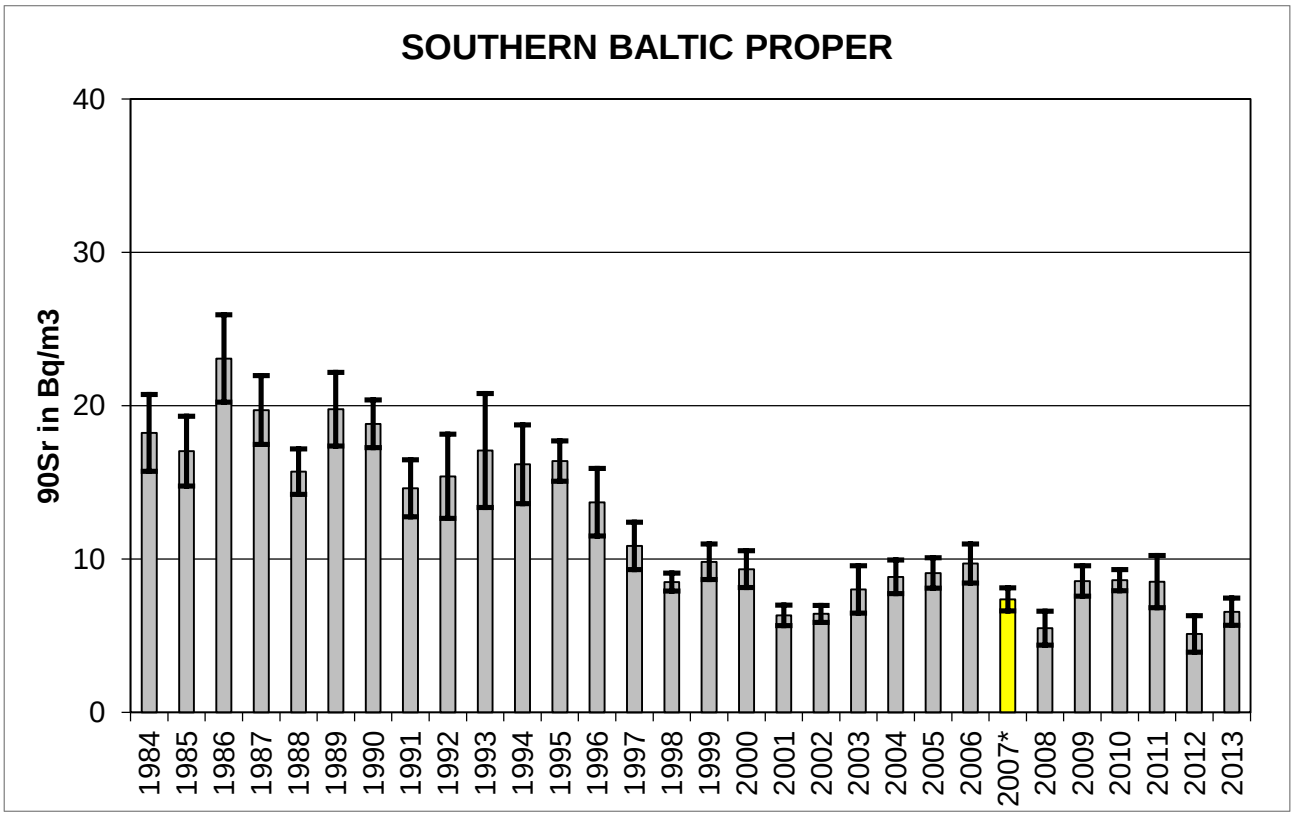


Figure 10f. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Southern Baltic Proper. Years containing values below limit of detection are indicated with asterisk (*) and yellow bar.

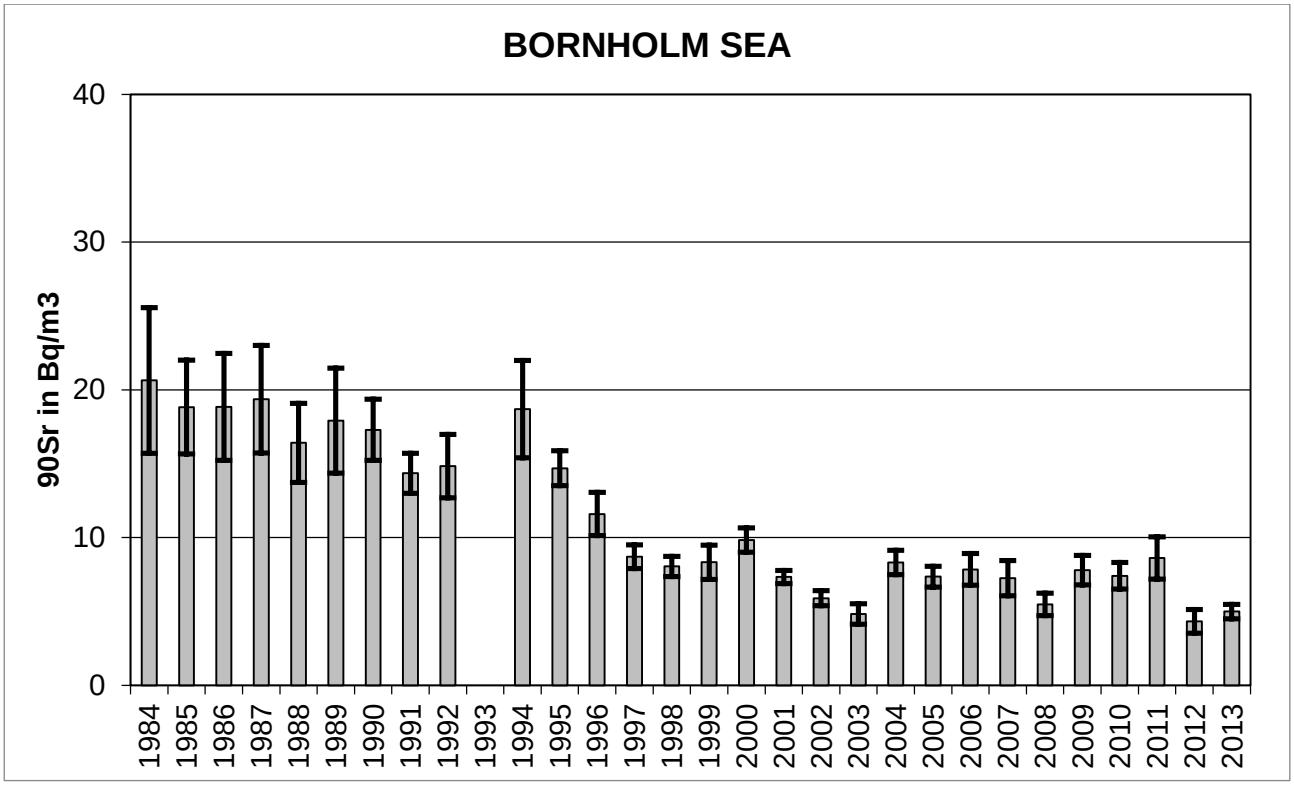


Figure 10g. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Bornholm Sea.

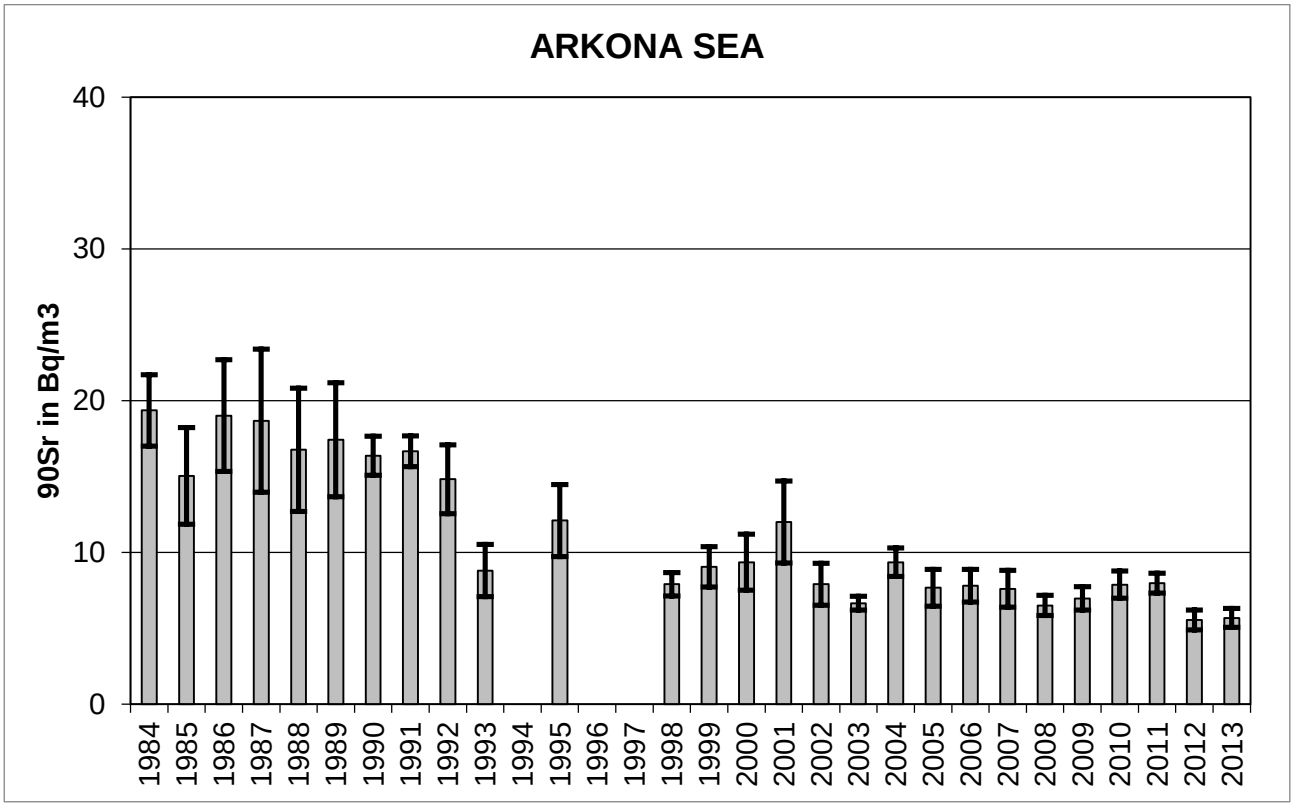


Figure 10h. ^{90}Sr (Bq/m^3) in bottom water 1984-2013 in Arkona Sea.

SEDIMENT: Figures 11a-h. ^{137}Cs (Bq/m^3) in sediment in 194-2013 (0-10 cm profile)

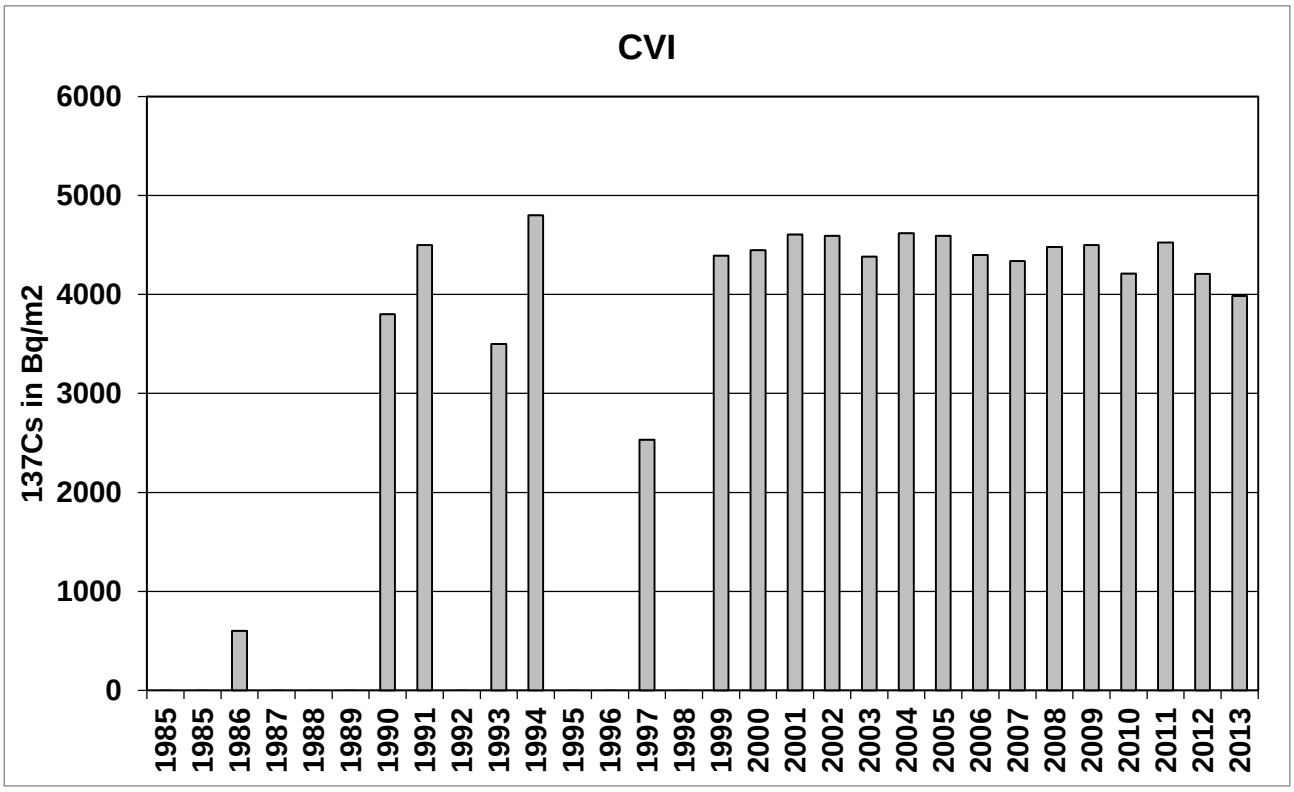


Figure 11a. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station CVI in Bothnian Bay.

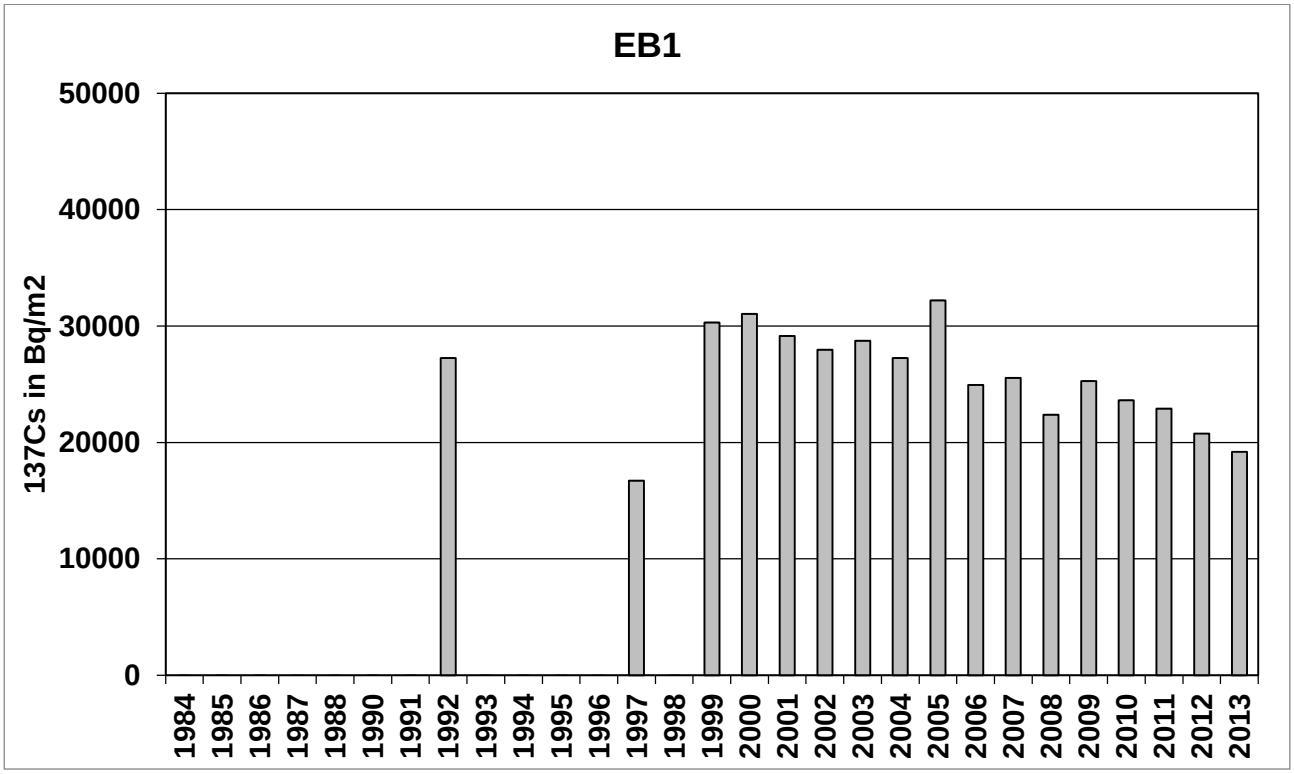


Figure 11b. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station EB1 in Bothnian Sea

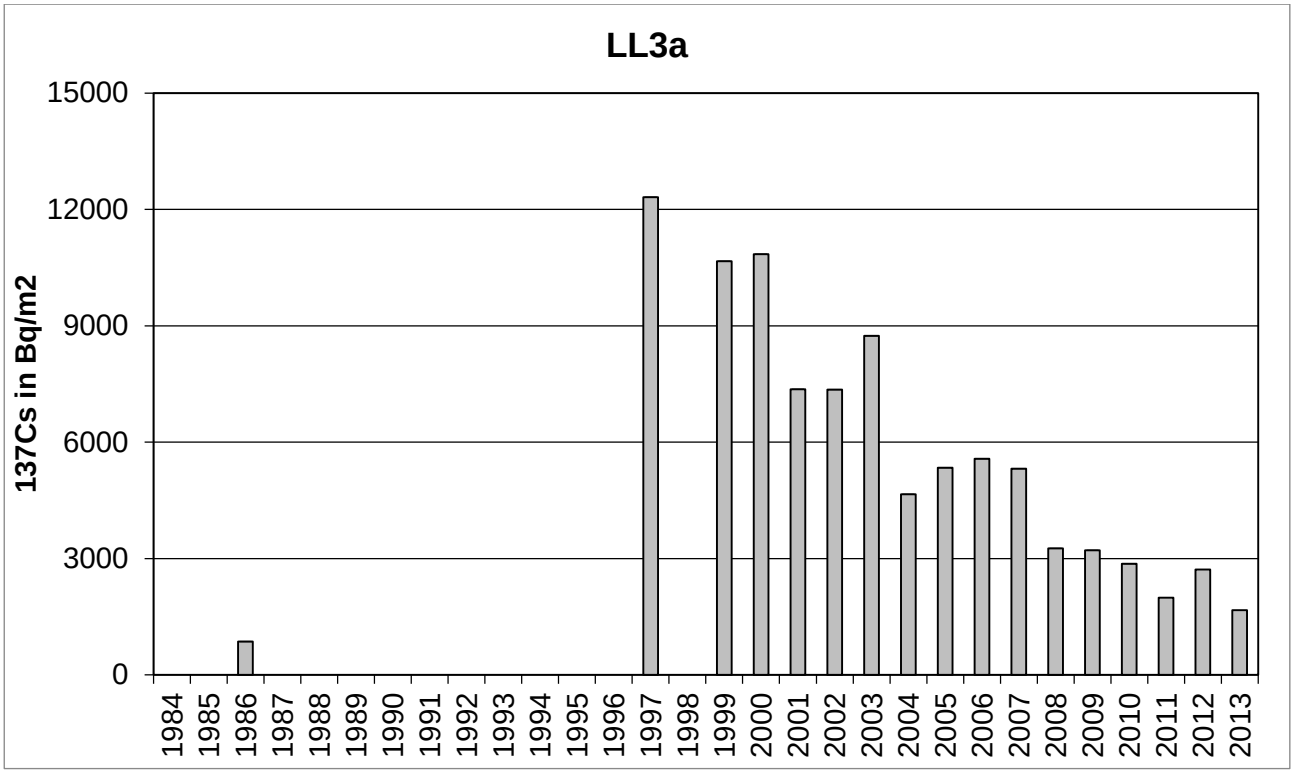


Figure 11c. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station LL3a in Gulf of Finland.

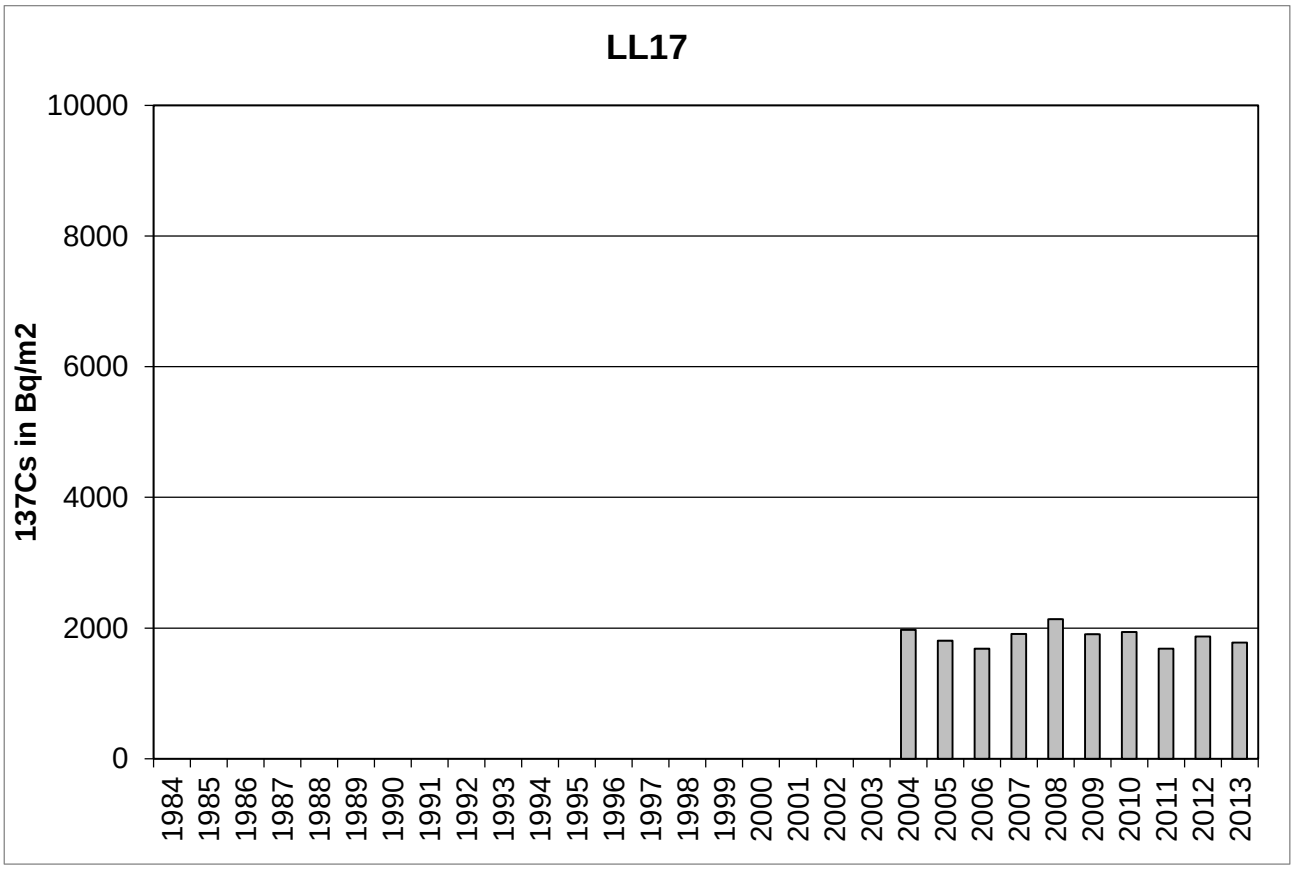


Figure 11d. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station LL17 in Northern Baltic Proper.

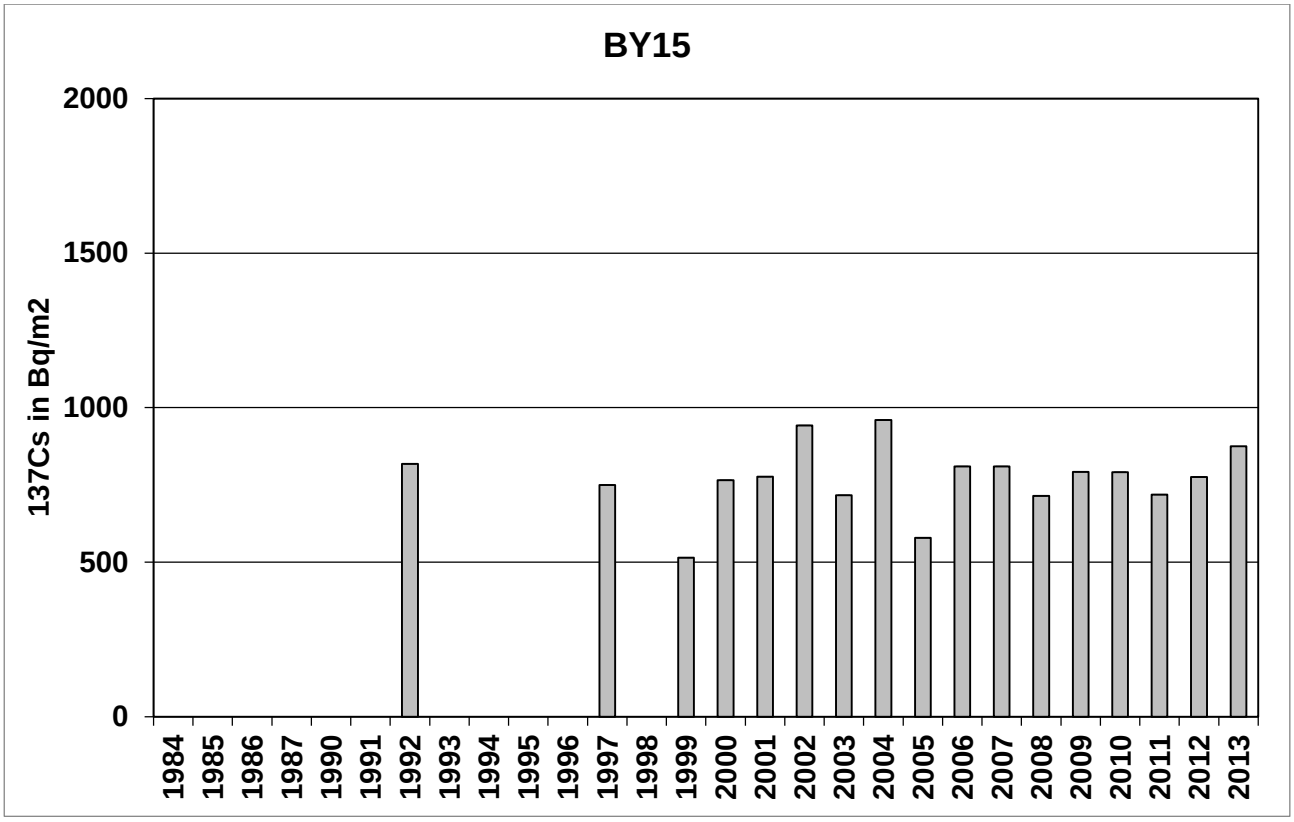


Figure 11e. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station BY15 in Gotland East.

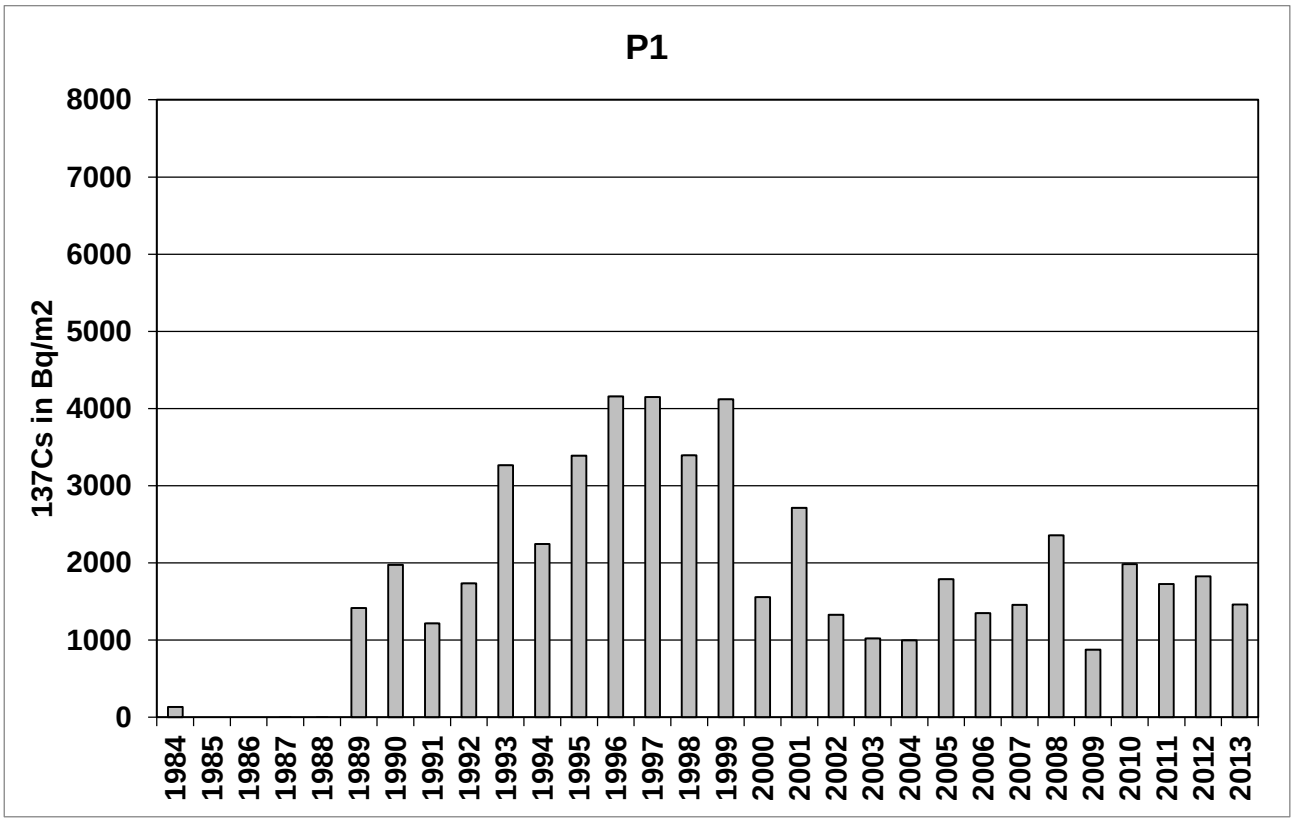


Figure 11f. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station P1 in Southern Baltic Proper

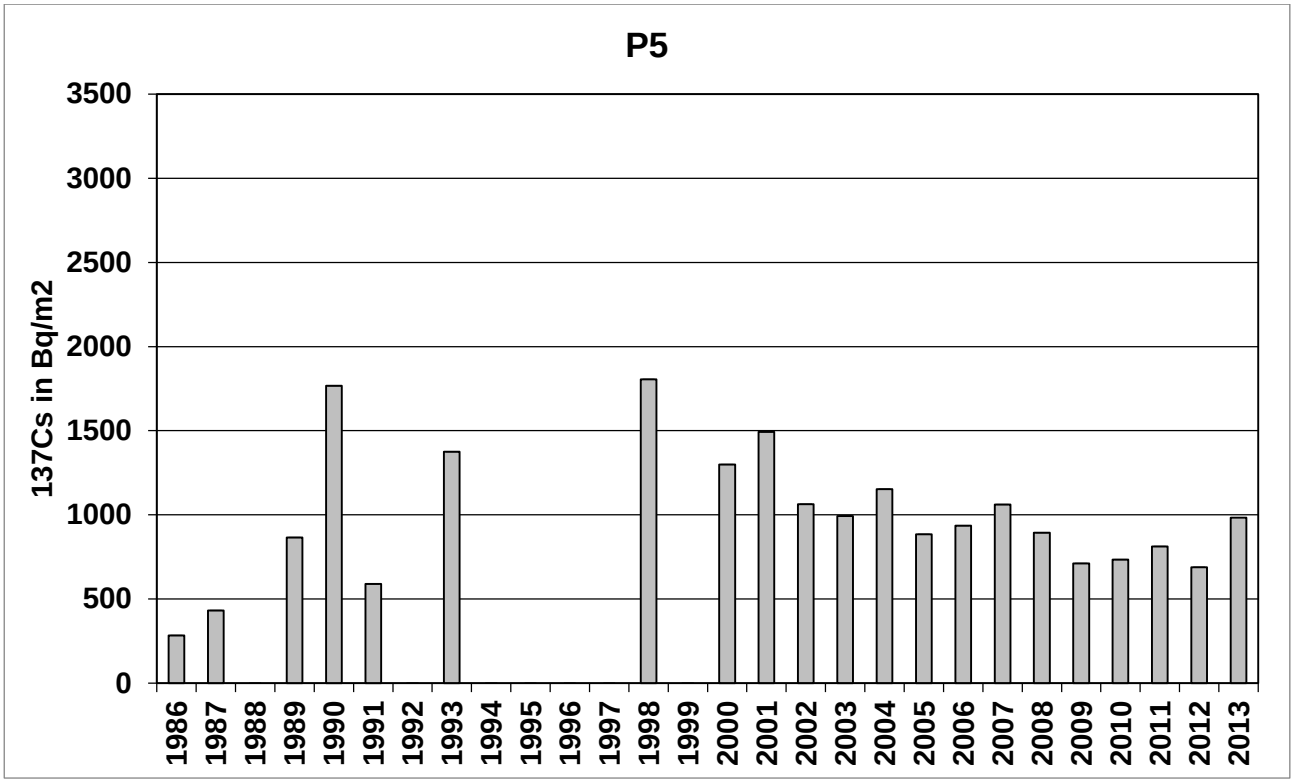


Figure 11g. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station P5 in Bornholm Sea.

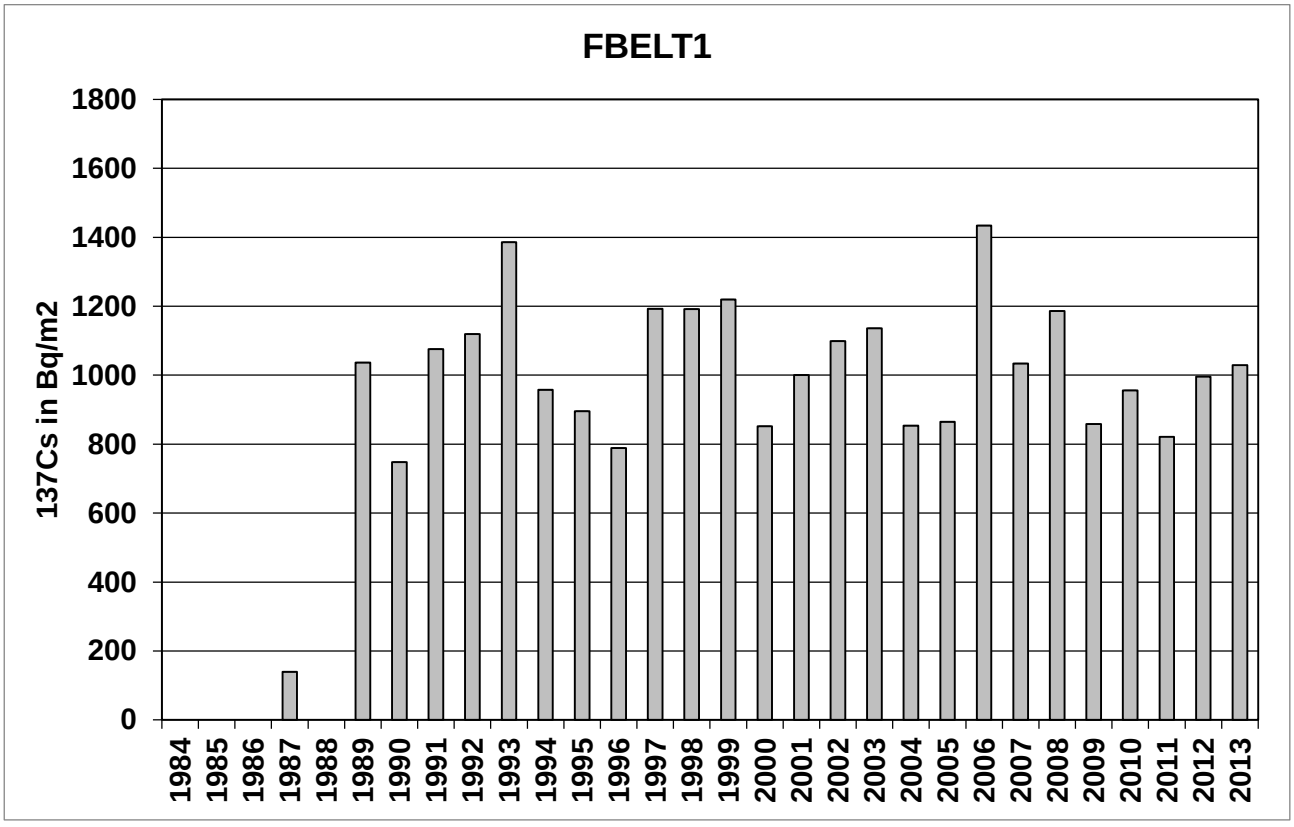


Figure 11h. ^{137}Cs (Bq/m^2) in sediment (0-10 cm) in 1984-2013 in Station FBELT1 in Belt Sea.