

# Analysis of BFRs

Bert van Bavel

MTM Research Center

Örebro University



**Pilot whale**  
FF1/3S09 – Photo: Paul Ensor



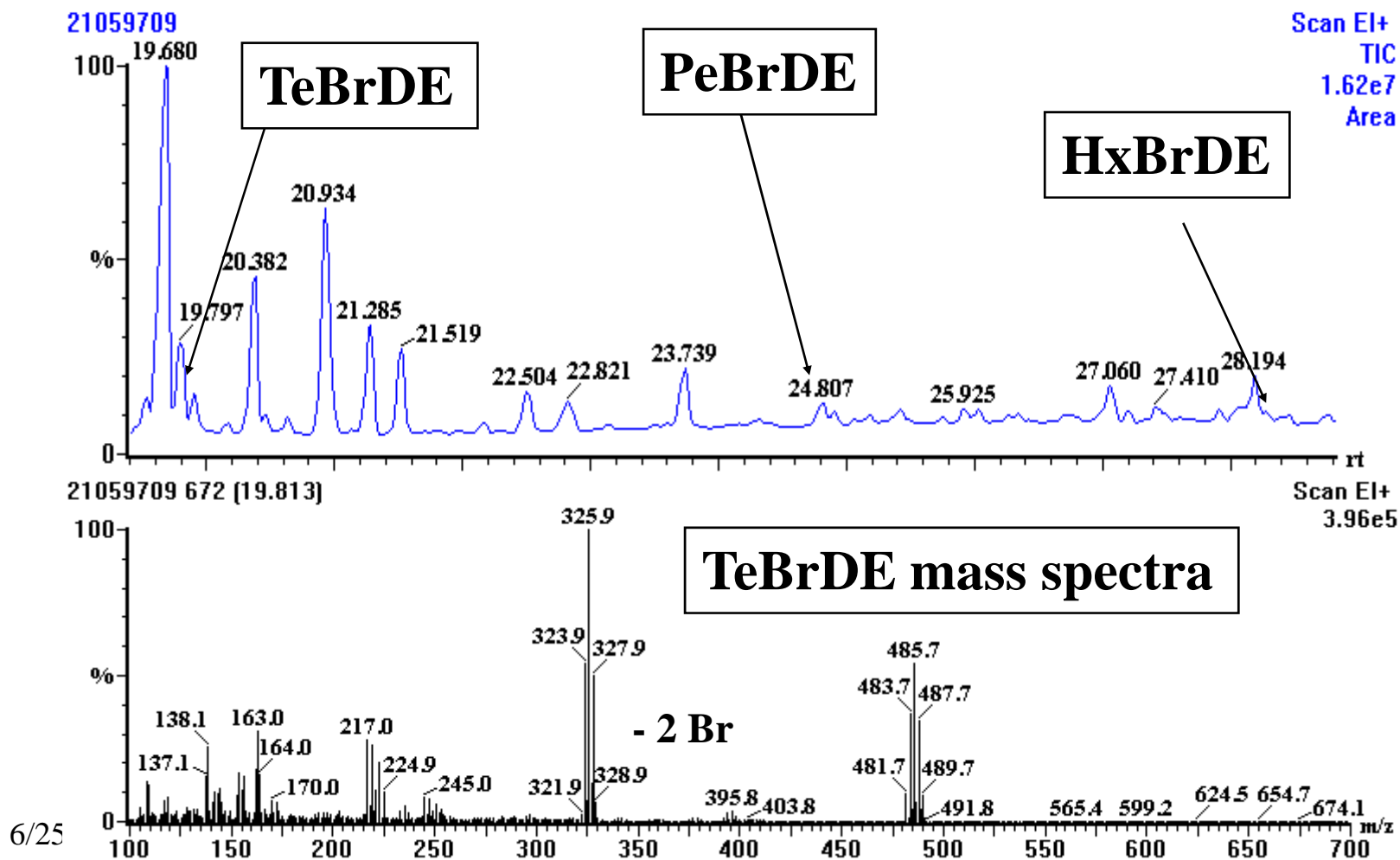
# Pilot Whale Hunting Faeroe Islands 1995



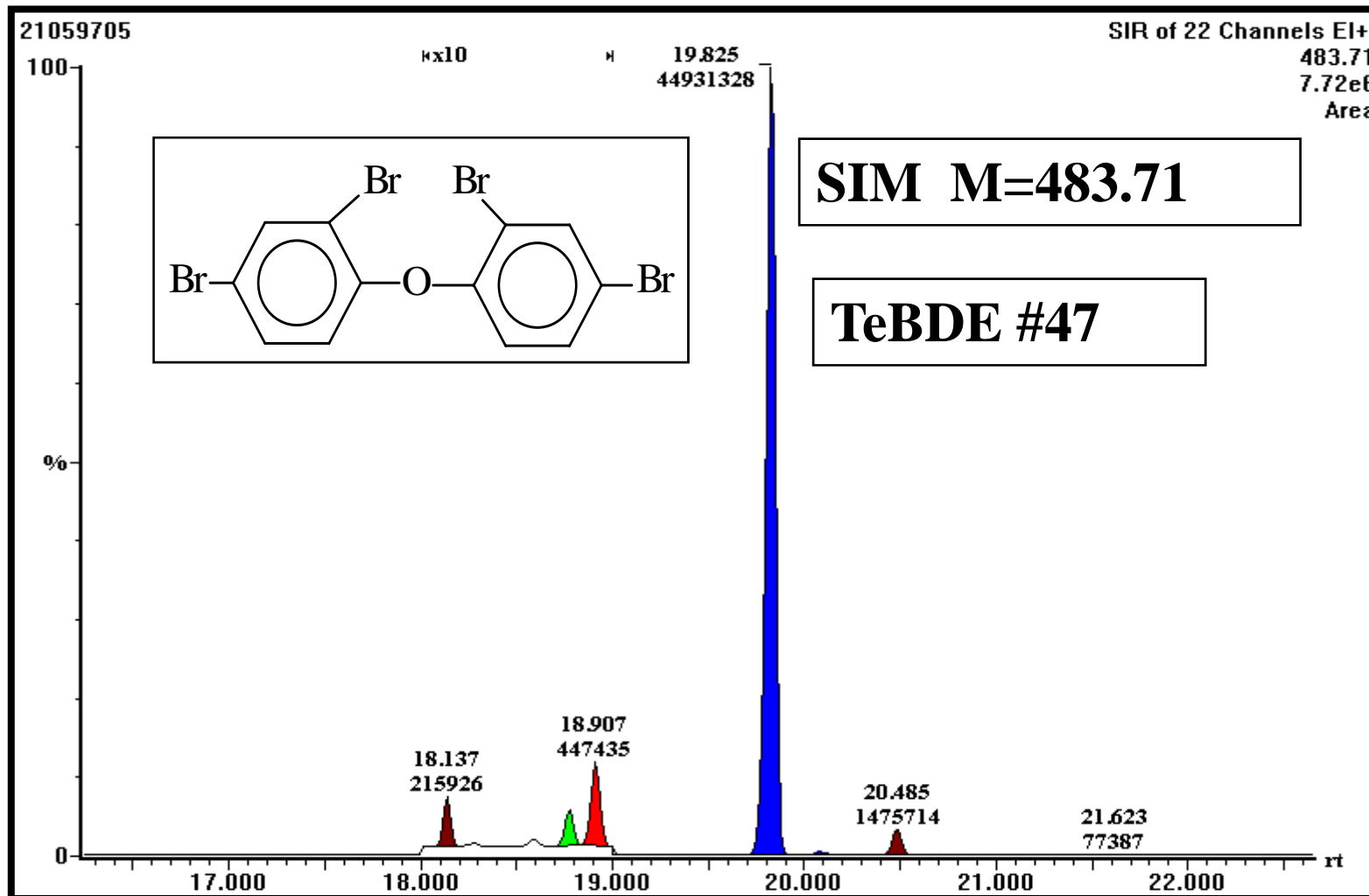
# Pilot Whale Hunting Faeroe Islands 1995



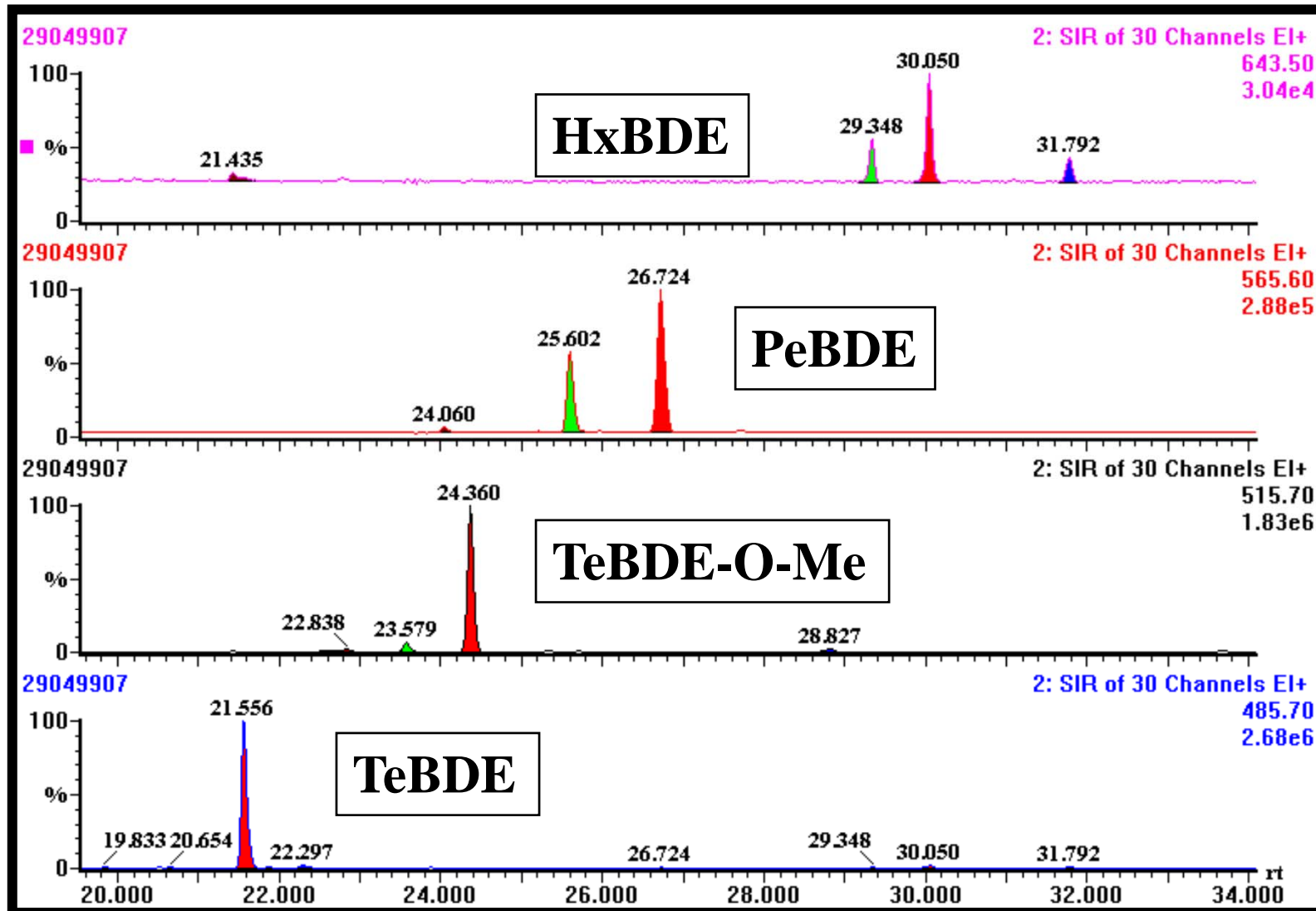
# Full scan GC/MS 1997



# Selective ion monitoring Tetra-BDEs in Whale (1997)



# PBDE in Pilot Whale (1997)



# PBDE-O-Me in Pilot Whale

	Adult males			Adult females		
<b>TeBDE-O-Me (a)</b>	<b>4.5</b>	<b>8.2</b>	<b>5.5</b>	<b>2.2</b>	<b>1.9</b>	<b>0.7</b>
<b>TeBDE-O-Me (b)</b>	<b>36.4</b>	<b>9.3</b>	<b>13.2</b>	<b>8.4</b>	<b>11.2</b>	<b>6.1</b>
<b>TeBDE-O-Me (c)</b>	<b>358.1</b>	<b>137.8</b>	<b>361.8</b>	<b>133.4</b>	<b>101.0</b>	<b>56.1</b>

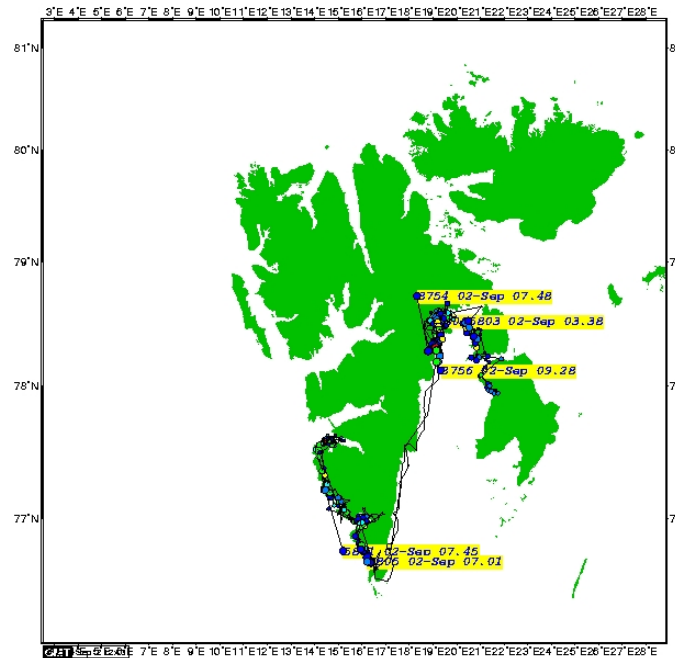
# PBDE in Pilot Whale



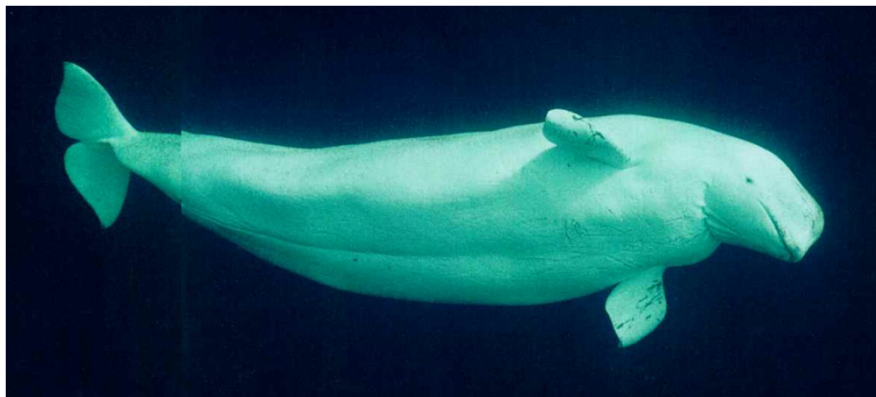
Bioaccumulation through Mothers Milk



# Satellite Telemetry 1998



- White Whale tracks
- Movement in front of glaciers
- Coastal movement
- Stationary in the Arctic (Spitsbergen)



# Beluga or White Whale



6/25/2014

	Juv. Male	Juv. Female	Ad. Female	Ad. Male
<b>TeBDE (d)</b>	<b>1.16</b>	<b>1.00</b>	<b>ND</b>	<b>1.60</b>
<b>TeBDE #47</b>	<b>137.43</b>	<b>106.21</b>	<b>17.53</b>	<b>78.39</b>
<b>PeBDE (d)</b>	<b>12.91</b>	<b>10.35</b>	<b>ND</b>	<b>7.52</b>
<b>PeBDE #99</b>	<b>9.11</b>	<b>7.77</b>	<b>ND</b>	<b>3.34</b>
<b>HxBDE (b)</b>	<b>3.48</b>	<b>5.15</b>	<b>ND</b>	<b>ND</b>
<b>TeBDE-O-Me (a)</b>	<b>1.84</b>	<b>1.76</b>	<b>ND</b>	<b>ND</b>
<b>TeBDE-O-Me (b)</b>	<b>19.48</b>	<b>15.70</b>	<b>ND</b>	<b>ND</b>
<b>TeBDE-O-Me (c)</b>	<b>143.02</b>	<b>125.56</b>	<b>23.55</b>	<b>84.19</b>

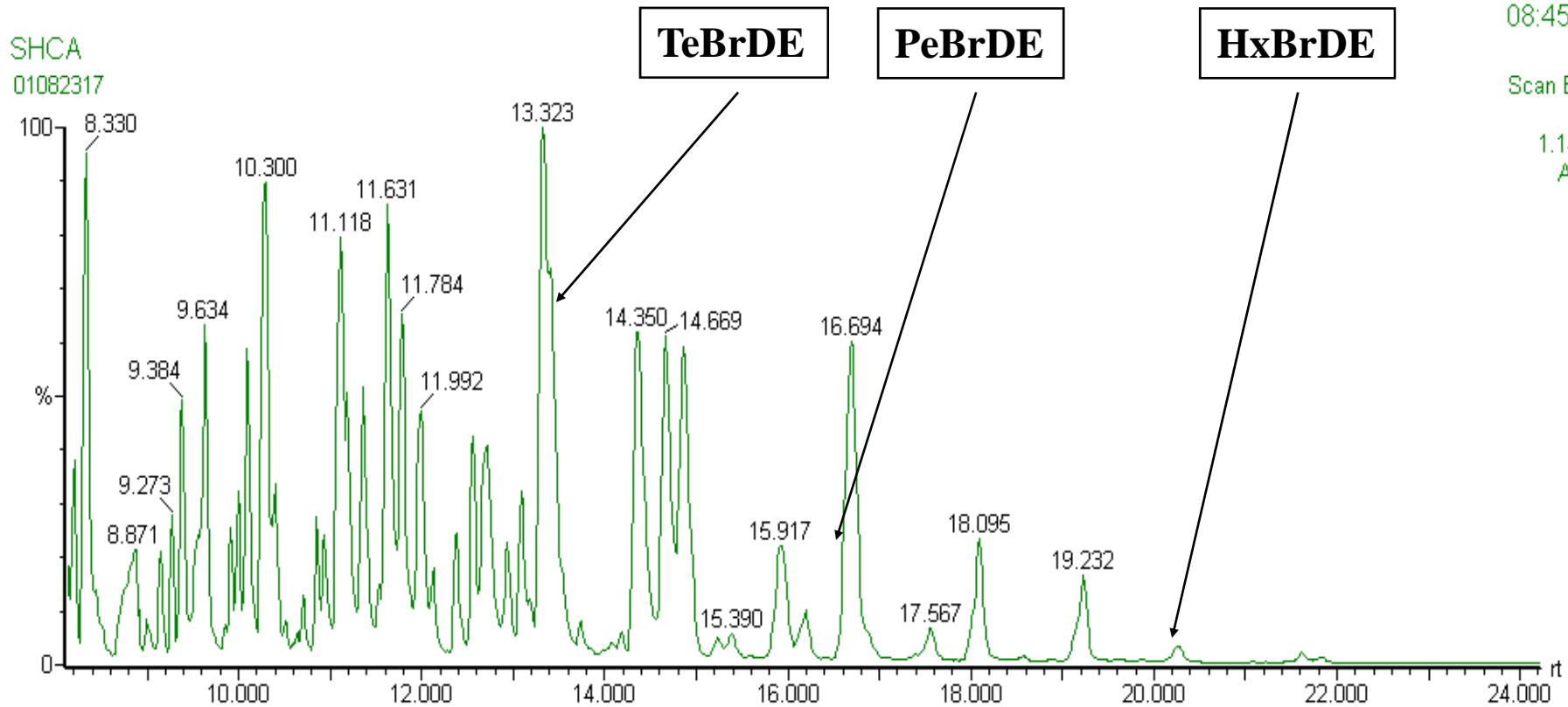
# Monterey Bay



6/25/2014

# Full scan GC/MS NCI Killer Whale Monterey Bay

24-Aug-2001  
08:45:00



# Full scan GC/MS NCI Killer Whale Monterey Bay

24-Aug-2001  
08:45:00

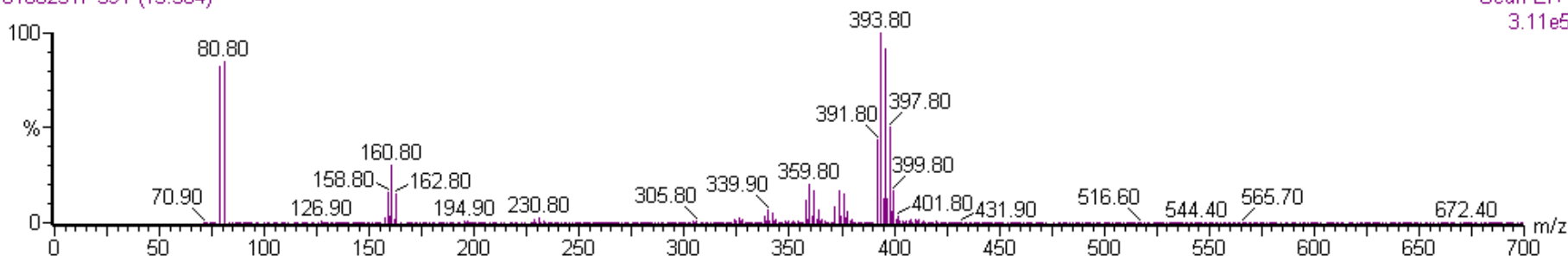
SHCA

Base Peak: 393.80, Base Peak Intensity: 310976

01082317 391 (13.504)

**TeBrDE**

Scan EI+  
3.11e5



24-Aug-2001  
08:45:00

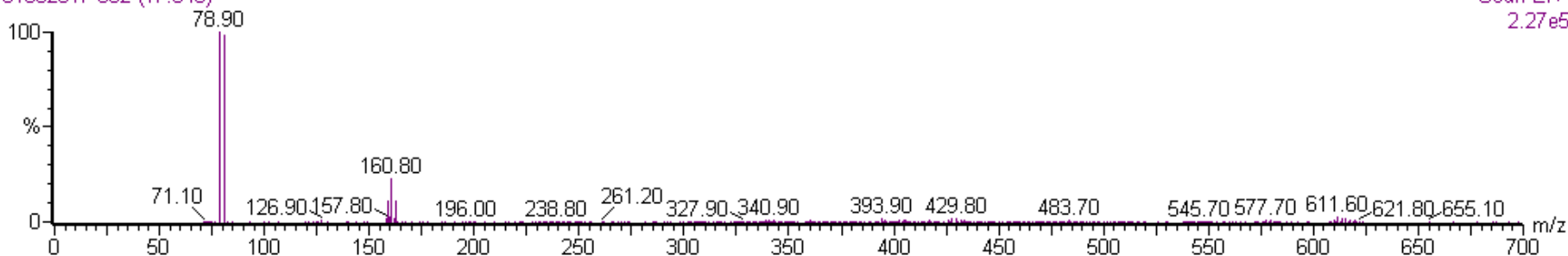
SHCA

Base Peak: 78.90, Base Peak Intensity: 227008

01082317 682 (17.540)

**PeBrDE**

Scan EI+  
2.27e5



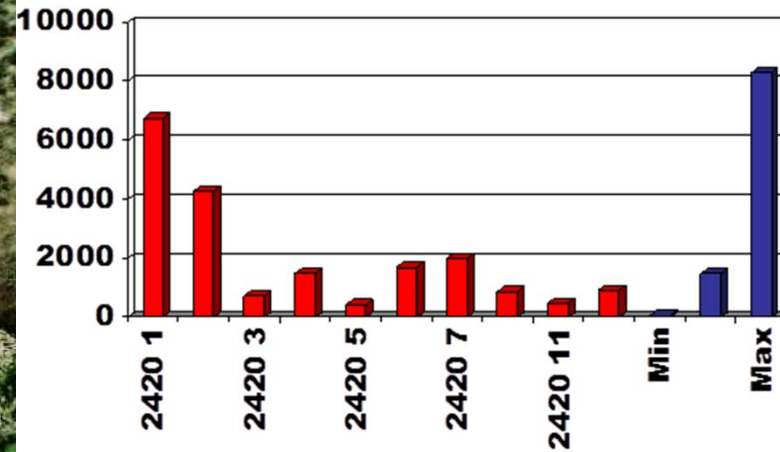
# PBDE in the Killer Whale Monterey Bay



6/25/2014

Lipid weight	0.023
	(ng/g lipid)
<b>TeBDE (a)</b>	<b>3</b>
<b>TeBDE (c)</b>	<b>10</b>
<b>TeBDE (d)</b>	<b>11</b>
<b>TeBDE #47</b>	<b>7823</b>
<b>TeBDE (f)</b>	<b>18</b>
<b>PeBDE #100</b>	<b>2911</b>
<b>PeBDE #99</b>	<b>1515</b>
<b>PeBDE (g)</b>	<b>6</b>
<b>HeBDE (a)</b>	<b>437</b>
<b>HeBDE #154</b>	<b>1806</b>
<b>HeBDE #153</b>	<b>786</b>
<b>Sum PBDE</b>	<b>15324</b>

# PBDE levels in Seal San Francisco Bay 2000



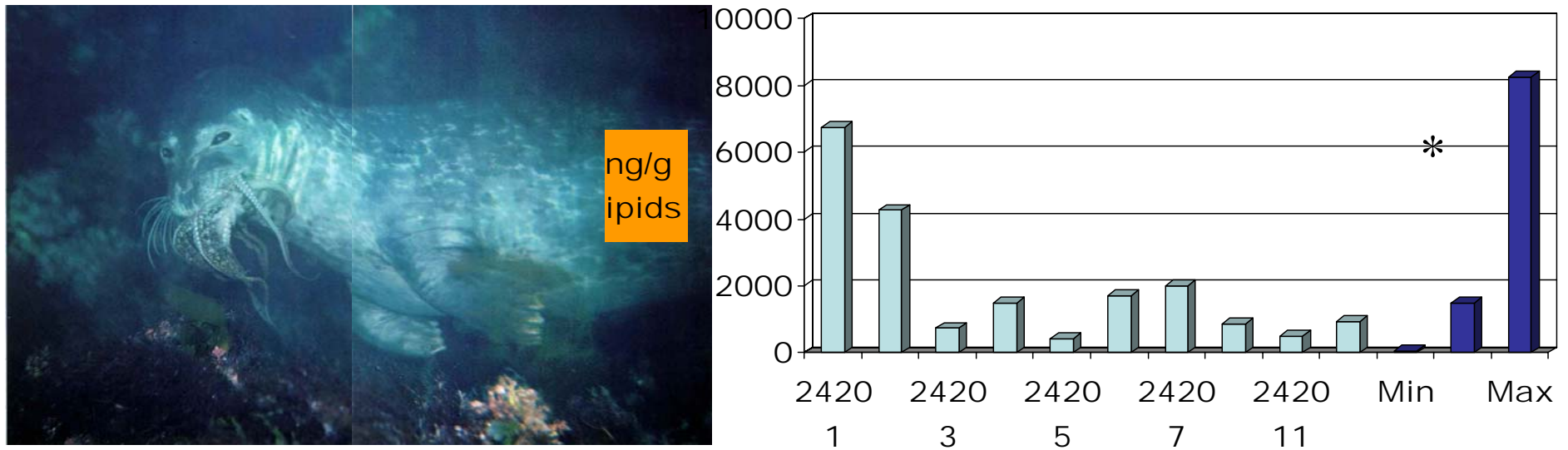
Average 2000 ng/g,  
\* She et al 1500 ng/g

# PBDEs in Harbor Seal San Francisco Bay





# PBDE levels in Seal San Francisco Bay



Average 2000 ng/g, \* She et al 1500 ng/g

# PBDE in the Killer Whale Monterey Bay



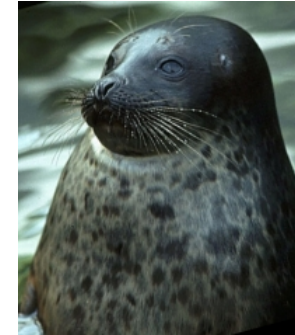
# Nordic Council Project

## Marine mammal species

- Arctic ringed seal (*Phoca hispida*)
- Hooded seal (*Cystophora cristata*)
- Long-finned pilot whale (*Globicephala melas*)
- Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
- Harbour porpoise (*Phocoena phocoena*)
- Fin whale (*Balaenoptera physalus*)
- Minke whale (*Balaenoptera acutorostrata*)



Hooded seal



Ringed seal



White-sided dolphin



Harbour porpoise



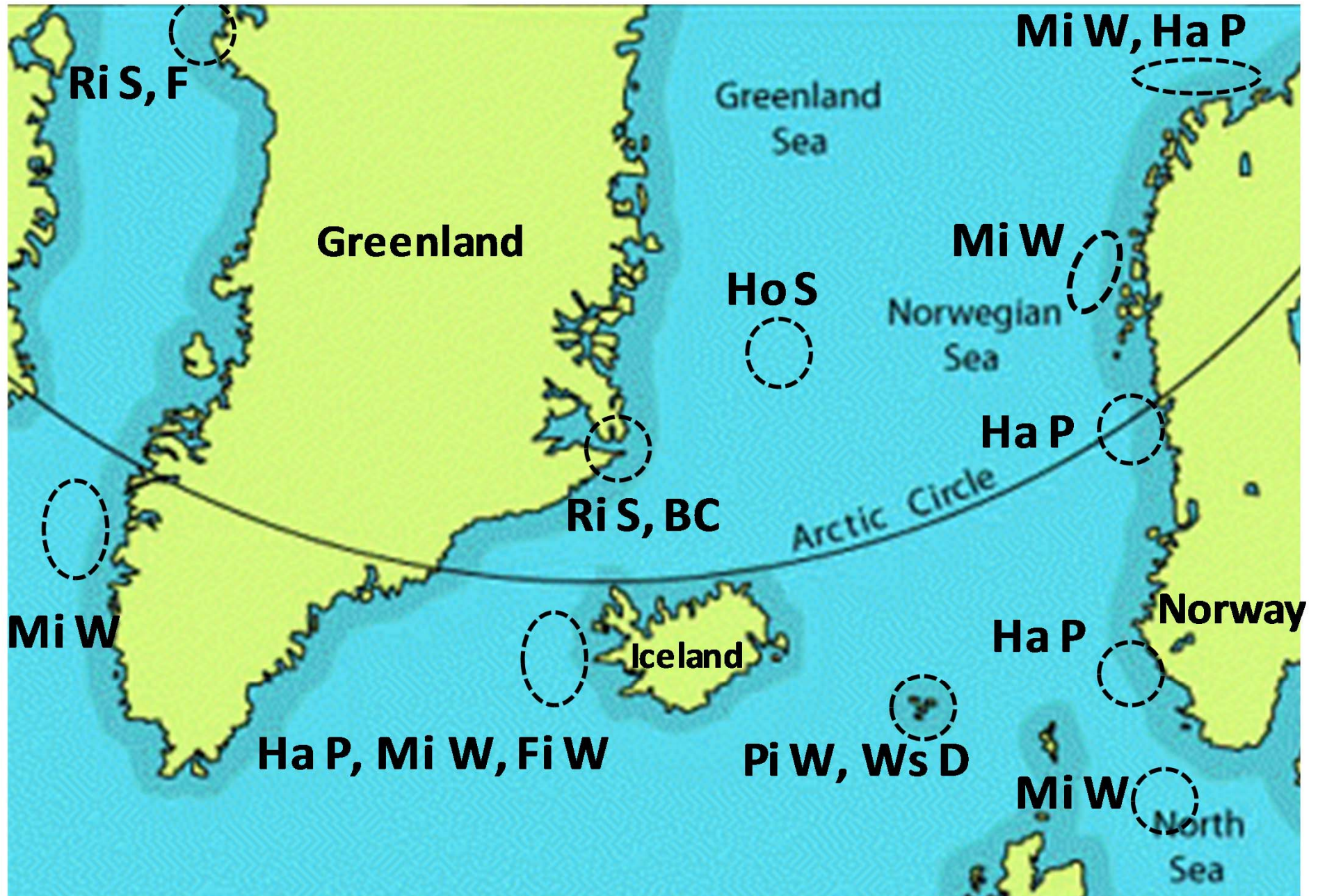
Minke whale



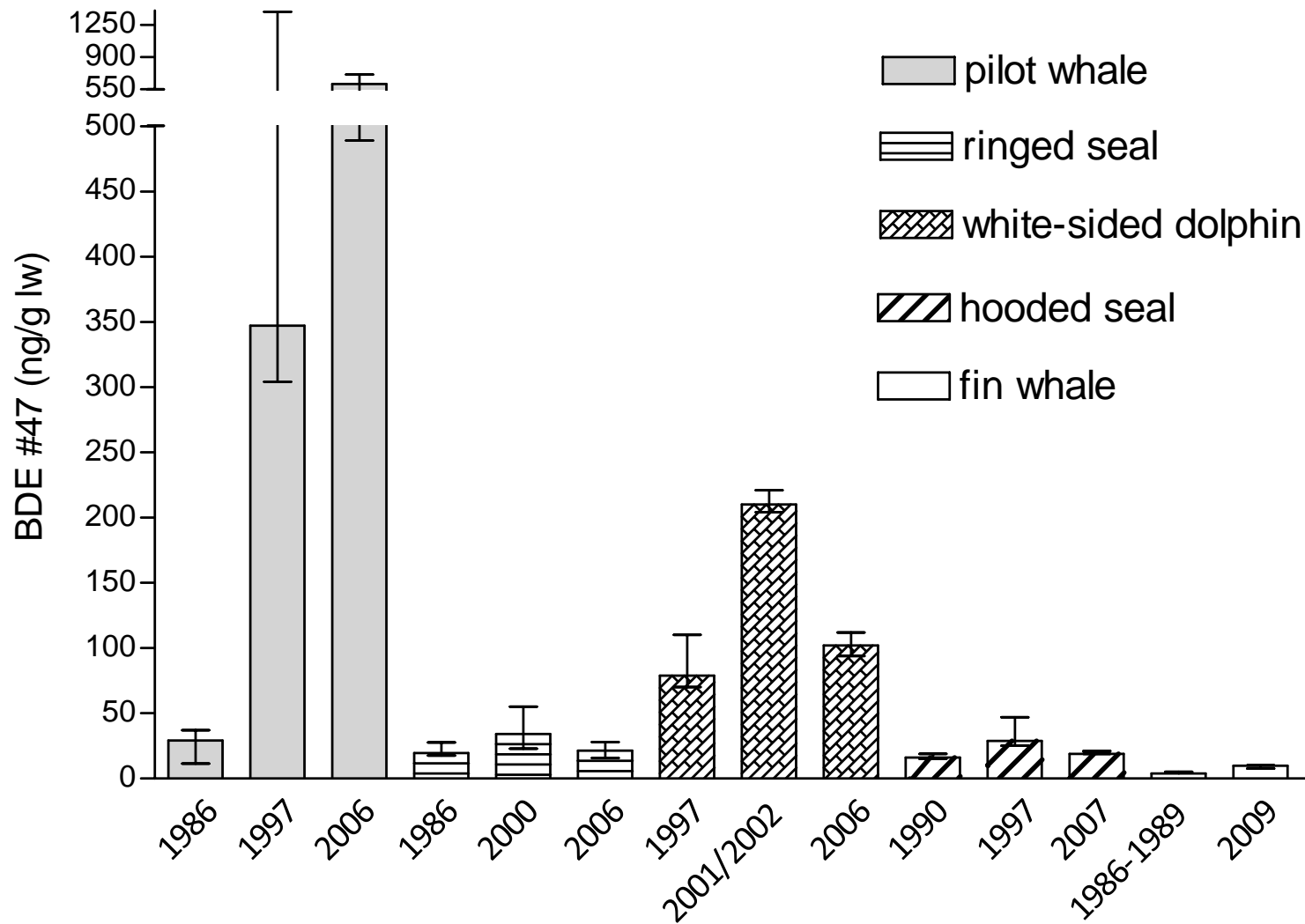
Fin whale



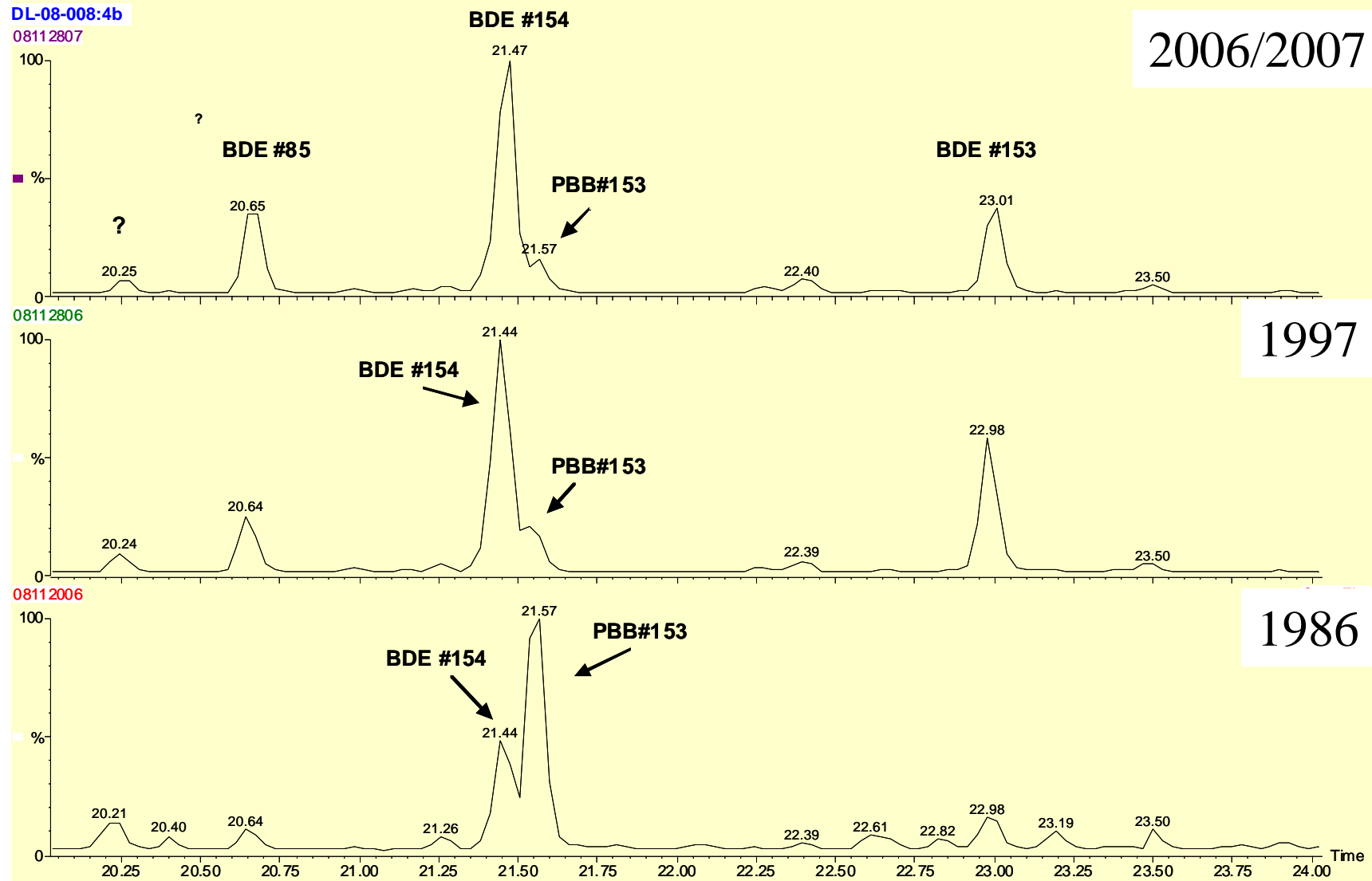
Pilot whale



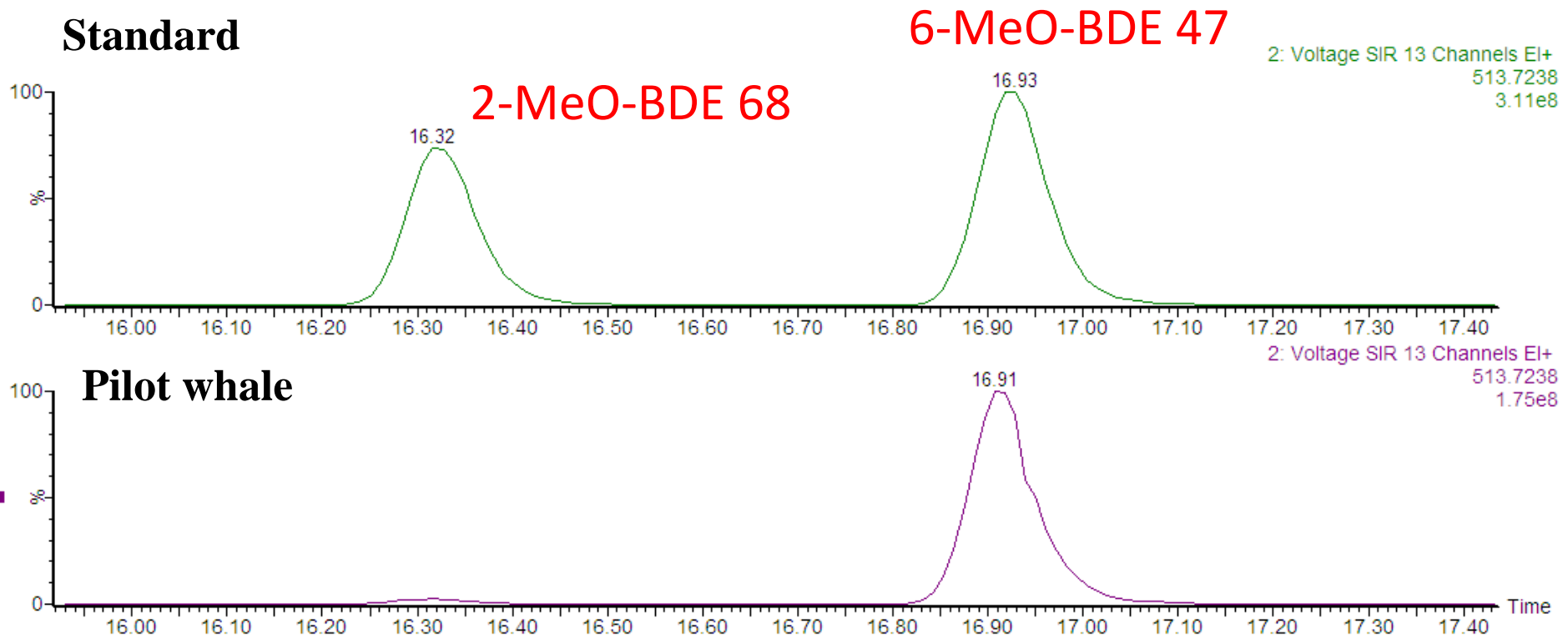
# BDE47



# BDE154 and PBB153 in pilot whale



# MeO-PBDE



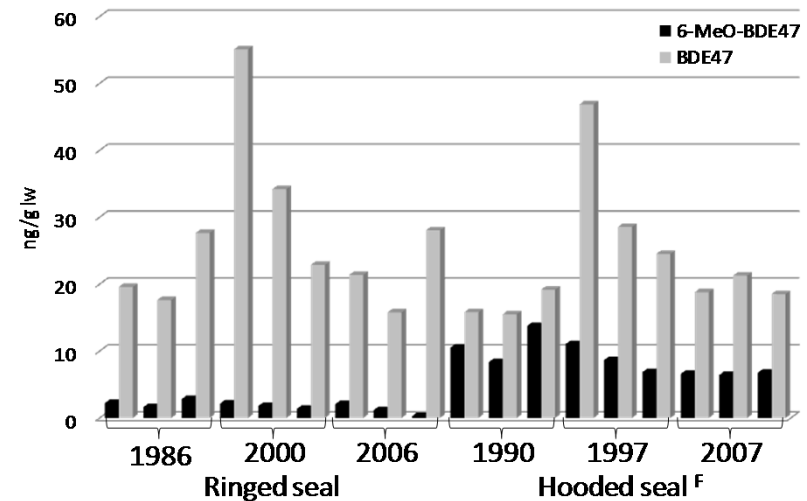
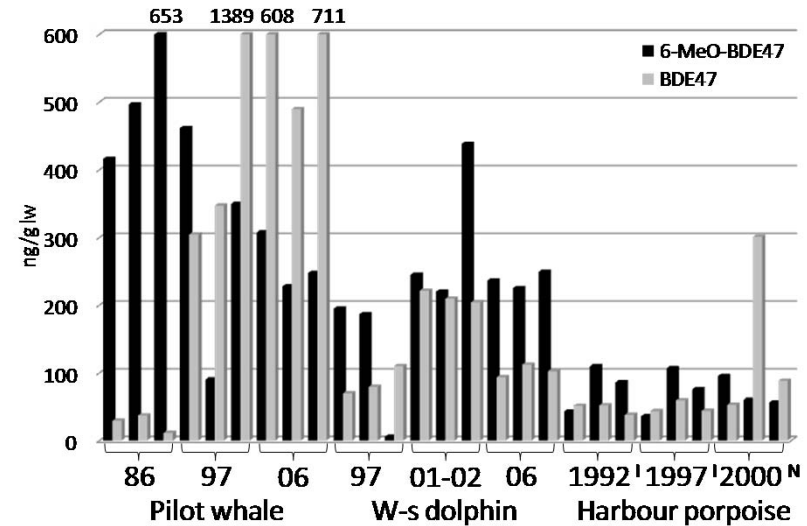
Pilot whale: 150-650 ng/g l.w. (n=3) (6-MeO-BDE 47)

Ringed seal: 0.3-3 ng/g l.w. (n=7)

Minke whale: 3-18 ng/g l.w. (n=6)

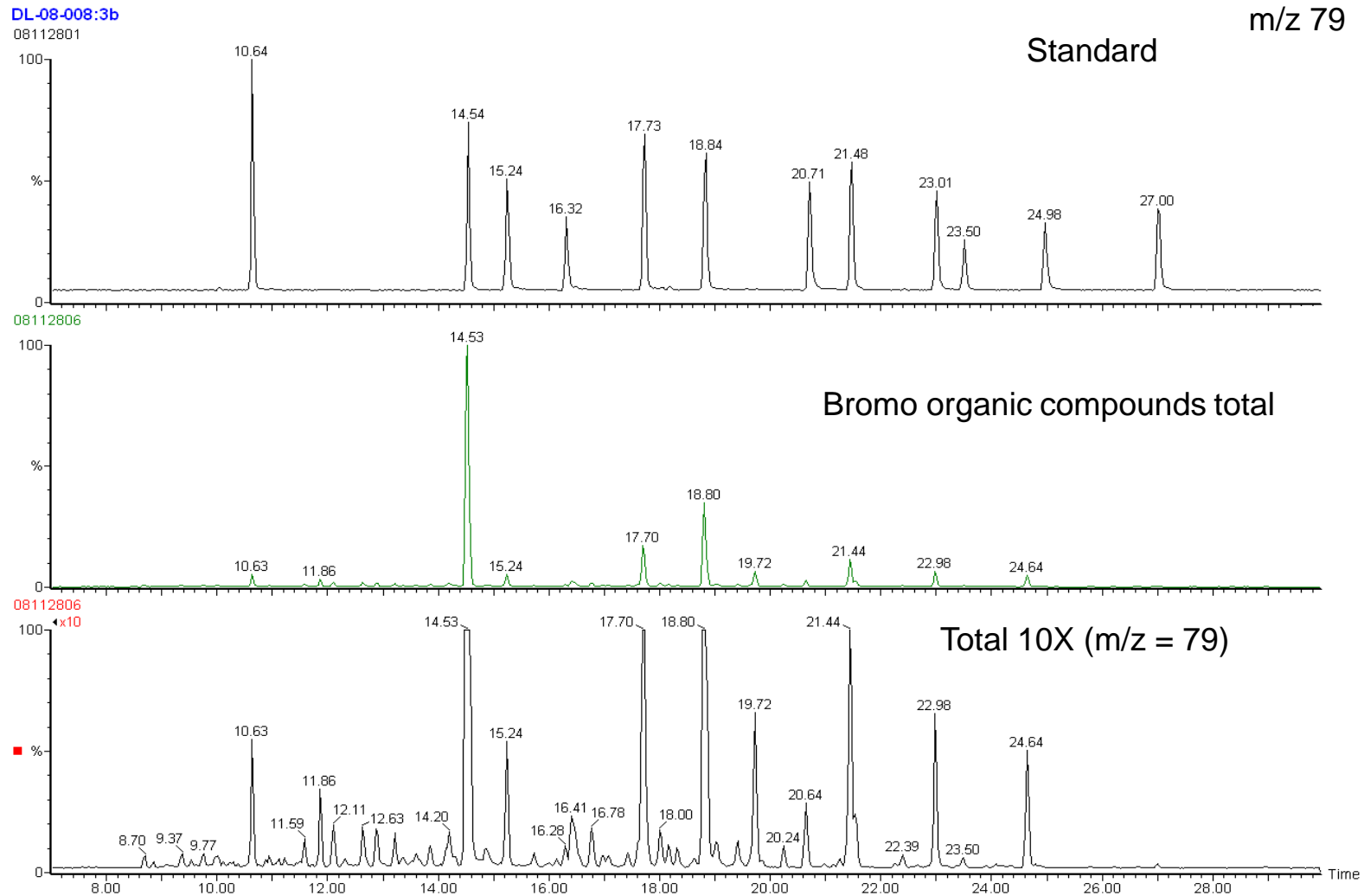
# MeO-PBDE

- MeO-PBDE levels highest in whale species.
- No or only weak correlation between PBDEs and MeO-PBDEs.
- Support for a natural formation of MeO-PBDEs.
  - Teuten et al. <sup>14</sup>C data
  - But metabolization cannot be ruled out.





# Other BFRs Pilot Whales 1986-1997-2006/07



# Nordic Council Project



**Anna Rotander**



**Guðjón Atli Auðunsson**

**Frank Rigét**

**Geir Wing Gabrielsen**

**Anuschka Polder**

**Maria Dam**



NATIONAL ENVIRONMENTAL  
RESEARCH INSTITUTE  
AARHUS UNIVERSITY



**Norwegian School of Veterinary Science**



MTM Research centre, Örebro University, Sweden

Innovation Center Iceland, Dep. Analytical Chem. And Marine Research Institute, Iceland

National Environmental Research Institute Dep. Arctic Environment, Denmark

Norwegian School of Veterinary Science and the Norwegian Polar Institute, Norway

Environment Agency and The Faroes museum of Natural History, The Faroe Islands