State of the Art on biomarker use for impact assessment

Drivers for use of biomarkers

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Drivers: regulators & industry

- OSPAR (Oslo Paris Convention)
  - JAMP (Joint Assessment and Monitoring Program)
- International Council for Exploration of the Seas (ICES) & International Oceanographic Committee (IOC) & the Oil & Gas industry: Becpelag workshop
- Norwegian Pollution Control Authority (SFT) & O&G industry: WCM 2003 & WCM 2004

History

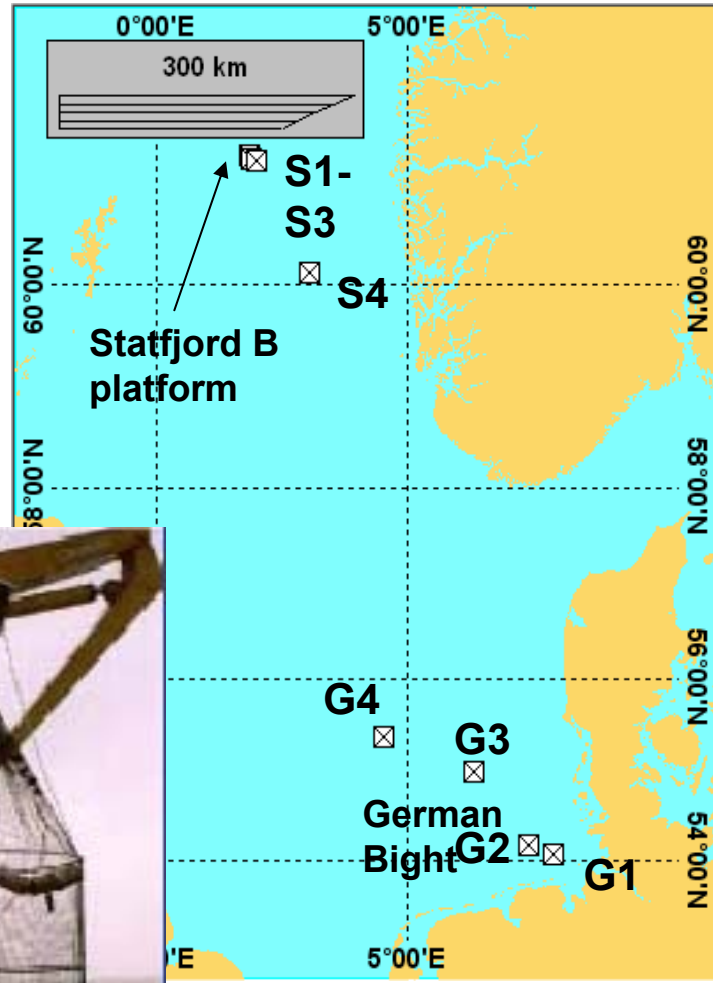
- 1999 Ekofisk area
  - Mainly body burden with mussels and SPMD
- 2000 Sleipner area
  - Mainly body burden with mussels and SPMD
- 2001 Tampen area
  - BECPELAG biomarkers and body burden (caged organisms) + wild caught fish
- WCM 2003 Troll area - Water column monitoring
  - Biomarkers and body burden (caged mussels and cod)
- WCM 2004 Tampen area currently under way
  - Biomarkers and body burden (caged mussels and cod) + wild caught fish

OSPAR JAMP

- ...June 1995, the Commissions decided implementation of the Joint Assessment and Monitoring Program;
- ... each participating country is an active part with an appropriate level of resources to achieve the common intention'.
- ...guidelines have been developed where two are relevant for recommended biomarkers:
  - Biological Effects in General (97-07e) -
    - incl. the biomarker 'Lysosomal stability'
  - Contaminant Specific Biological Effects (98-03e),
    - the most relevant for oil specific discharges
    - incl. PAH specific markers: EROD, PAH bile metabolites, DNA adducts and Liver pathology.

BECPelag: Biological Effects of Contaminants in Pelagic ecosystem

- North Sea (Statfjord area, German Bight)
  - 7 cruises
  - Participants from North sea countries
- Seagoing biomarker workshop
  - Exposure of caged organisms (mussel, cod)
  - Catch of wild fish (herring, saithe, mackerel)
- Effect focus - biomarkers, also chemistry, bioassays



State of the art biomarkers within EIA

RF-Akvamiljø

WCM 2003

- The rationale was to assess whether chemicals discharged from a production platform affect organisms in the water column and estimate the area of influence. (Troll B was chosen)
- A suite of biomarkers and histopathology were chosen on basis of the reported chemical profile for the Troll B discharge and the recommendations from the ICES workshop “Biological Effects of contaminants in the Pelagic ecosystem, BECPELAG”
- The risk assessment was based on a combination of biomarker and chemical analyses.
- Troll B is a platform with little PW

Definition

- The WCM2003 is not a monitoring of ACTUAL biological effects on an ecological level (like a sediment impact assessment)
- But it is a RISK monitoring based on effects measured in organisms deployed for a short period in a discharge gradient

WCM 2003

Method	Matrix
EROD	Cod liver
GST	Cod liver
DNA-adducts	Cod liver
PAH-metabolites	Cod bile, FF and GCMS
Vitellogenin	Cod blood plasma
Histopathology/-chemistry	Cod liver, gonad & kidney Mussel digestive gland a.o.
BaPH activity	Mussel hepatopancreas
Lysosomal stability	Mussel hematocytes
Lipid content	Mussel whole tissue
Body burden (NPD, PAHs & decalins)	Mussel whole tissue

WCM 2004

- Statfjord B - Tampen area
- Area known to have a larger discharge of PW (compared to WCM2003)
- Same area than Becpelag
- Wild fish in addition to caged mussel and cod

WCM 2004

Method	Matrix
EROD	Cod liver
GST	Cod liver
DNA-adducts	Cod liver
PAH-metabolites	Cod bile FF and GCMS
Vitellogenin	Cod blood plasma
Histopathology/-chemistry	Cod liver, gonad & kidney Mussel digestive gland a.o.
Micronucleus	Cod
BaPH activity	Mussel hepatopancreas
Lysosomal stability	Mussel hematocytes
Lipid content	Mussel whole tissue
Body burden (NPD, PAHs & decalins)	Mussel whole tissue