GdR AMURE

10-11 May 2007

Methods for Assessing Oil Spill Impact on the Marine Environment

Dr Torsten Möller

Managing Director

ITOPF

Why study spill effects?

- Academic Research
- Support for Punitive Measures
- Environmental Conservation
- Compensation and Restoration

Role of Science

- **International compensation regime**
- **Fisheries and mariculture**
- **Environmental impact & restoration**
- **Wider perspectives**

Compensation Conventions

- **Civil Liability Conventions (69 & 92)**
- **Fund Conventions (92 & 03)**
- **Bunker Convention (not yet in force)**
- **HNS Convention (not yet in force)**

SCOPE OF COMPENSATION

Reasonable costs associated with:

- Preventive measures (clean-up)
- Property damage
- Economic loss
- Environmental damage (restoration)

POLLUTION DAMAGE

- Loss or damage caused... by contamination resulting from... [a tanker spill]... including... the costs of preventive measures and further loss or damage caused by preventive measures
- “Preventive measures” mean any reasonable measures taken by any person after an incident has occurred to prevent or minimize pollution damage

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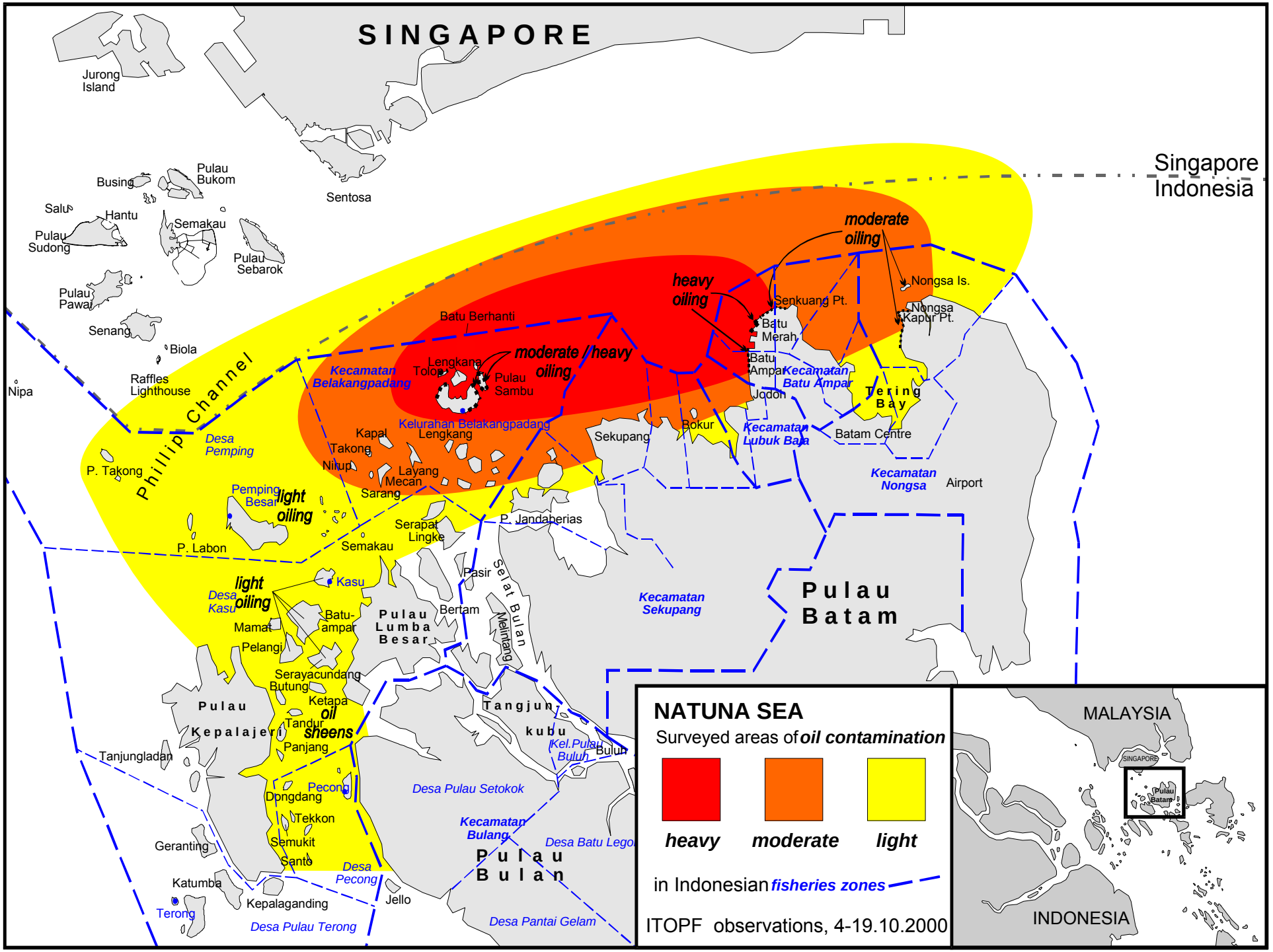
Reasonable measures should

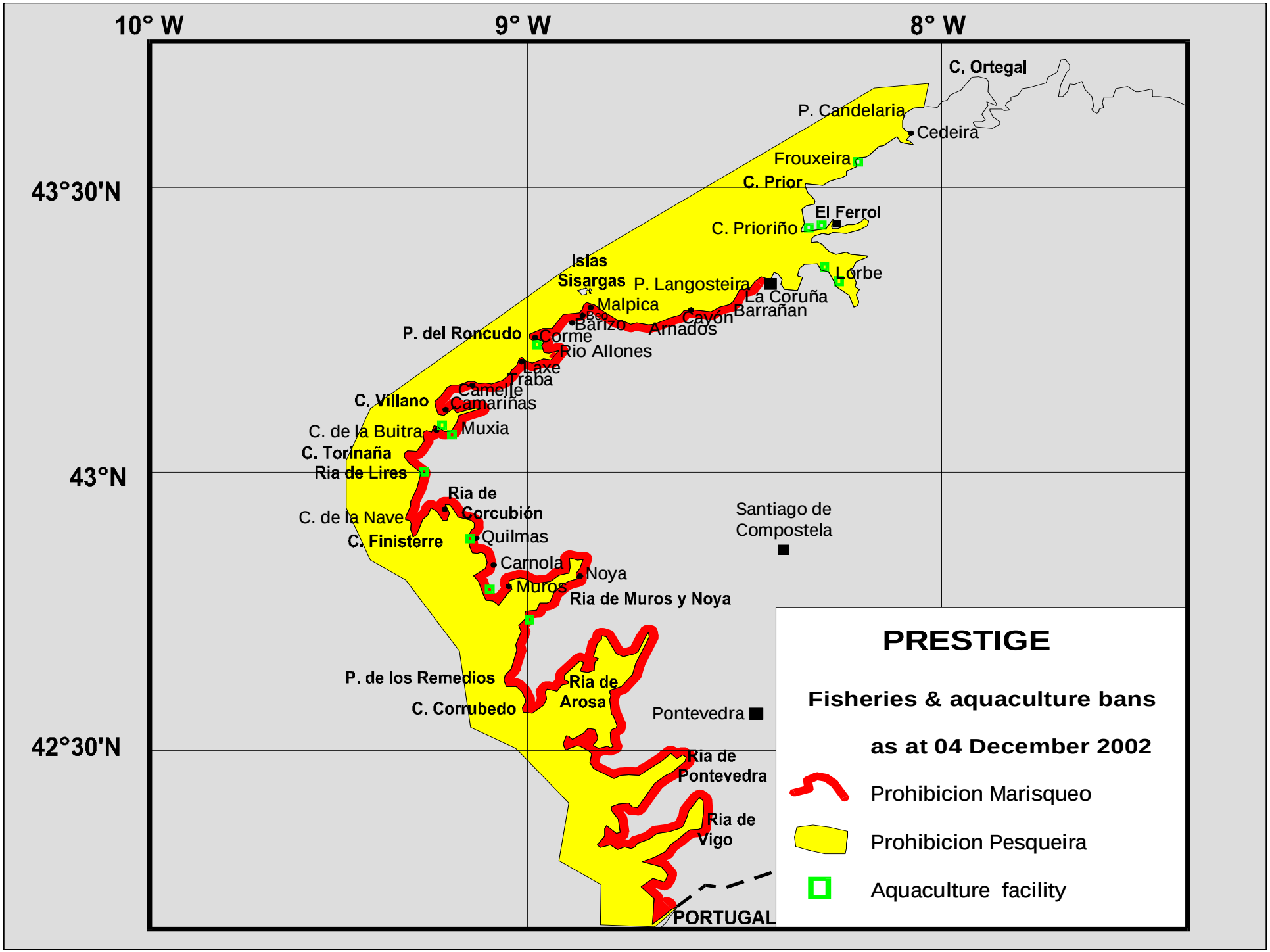
- prevent or reduce Pollution Damage
- be based on a technical appraisal
- seek to enhance natural processes
- entail proportionate costs

Assessment of claims is made on the basis of available evidence of damage

FISHERIES & AQUACULTURE

- Joint inspections / surveys
- Interviews with fishermen / operators
- Proof of ownership / purchase
- Photographic evidence
- Analysis of catch / production data


SINGAPORE
Jurong Island
Sentosa
Singapore
Indonesia
Busing
Pulau Bukom
Salu
Hantu
Pulau Sudong
Semakau
Pulau Sebarok
Pulau Pawai
Senang
Biola
Nipa
Raffles Lighthouse
Phillip Channel
Batu Berhanti
moderate oiling
heavy oiling
moderate / heavy oiling
Nongsa Is.
Senkuang Pt.
Nongsa Kapur Pt.
Batu Merah
Batu Ampar
Kecamatan Belakangpadang
Kecamatan Batu Ampar
Tering Bay
Lengkang
Tolop
Pulau Sambu
Jodoh
Kelurahan Belakangpadang
Kapal
Lengkang
Takong
Nikup
Layang
Mecan
Sarang
Sekupang
Bokur
Kecamatan Lubuk Baja
Batam Centre
Kecamatan Nongsa
Airport
Desa Pemping
P. Takong
Pemping Besar
light oiling
P. Jandaberias
Serapat Lingke
P. Labon
Semakau
Kasu
light oiling
Desa Kasu
Pasir
Selat Bulan
Kecamatan Sekupang
Pulau Batam
Batu-ampar
Pulau Lumba Besar
Bertam
Mamat
Pelangi
Melintang
Serayacundang
Butung
Ketapa
Pulau Kepalajeri
oil sheens
Tandur
Panjang
Tangjung kubu
Kel.Pulau Buluh
Buluh
Tanjungladan
Pecong
Dpngdang
Desa Pulau Setokok
Tekkon
Kecamatan Bulang
Semukit
Geranting
Santo
Desa Batu Lego
Desa Pecong
Pulau Bulan
Katumba
Kepalaganding
Jello
Terong
Desa Pulau Terong
Desa Pantai Gelam
NATUNA SEA
Surveyed areas of oil contamination
heavy
moderate
light
in Indonesian fisheries zones
ITOPF observations, 4-19.10.2000
MALAYSIA
SINGAPORE
Pulau Batam
INDONESIA


10° W
9° W
8° W
43°30'N
43°N
42°30'N
C. Ortegal
P. Candelaria
Cedeira
Frouxeira
C. Prior
El Ferrol
C. Prioriño
Lorbe
Islas Sisargas
P. Langosteira
La Coruña
Malpica
Barrañan
Cayón
Arnados
Barizo
Baio
P. del Roncudo
Corme
Rio Allones
Laxe
Traba
Camelle
C. Villano
Camariñas
C. de la Buitra
Muxia
C. Torinaña
Ria de Lires
Ria de Corcubión
C. de la Nave
C. Finisterre
Quilmas
Carnola
Noya
Muros
Ria de Muros y Noya
Santiago de Compostela
P. de los Remedios
C. Corrubedo
Ria de Arosa
Pontevedra
Ria de Pontevedra
Ria de Vigo
PORTUGAL
PRESTIGE
Fisheries & aquaculture bans
as at 04 December 2002
Prohibicion Marisqueo
Prohibicion Pesqueira
Aquaculture facility

FISHERIES & HARVESTING BANS

Aims and strategies

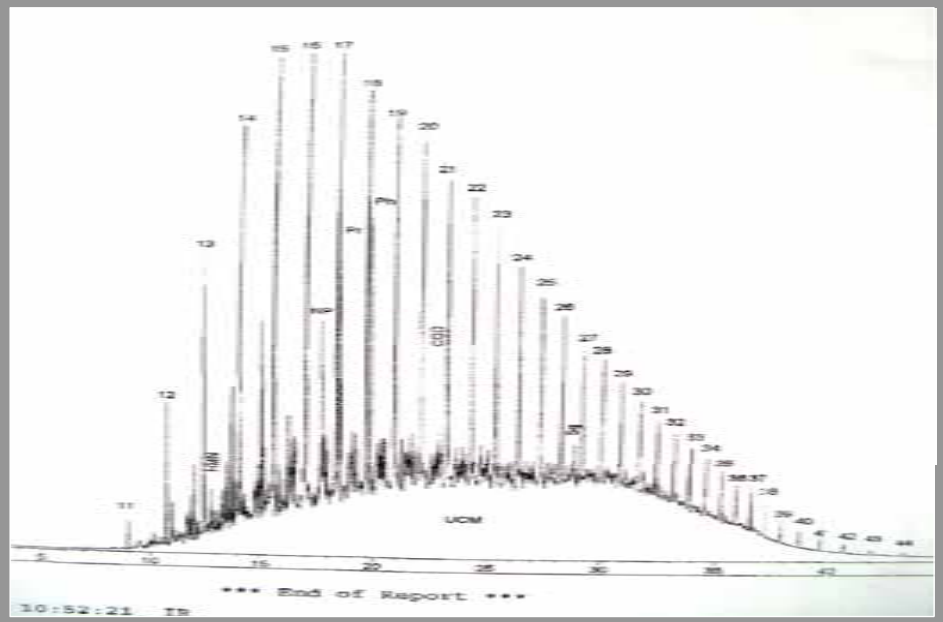
- Prevent tainted seafood from reaching market
- Cost-benefit analysis
- Objective scientific evidence
- Select re-opening criteria in advance of closure

FISHERIES & HARVESTING BANS

Re-opening criteria

- **Sea surface visually free of oil and sheen**
- **Is there a problem with sunken oil?**
- **Commercial species free of taint**
- **Chemical analysis and reference data**

Fisheries Monitoring



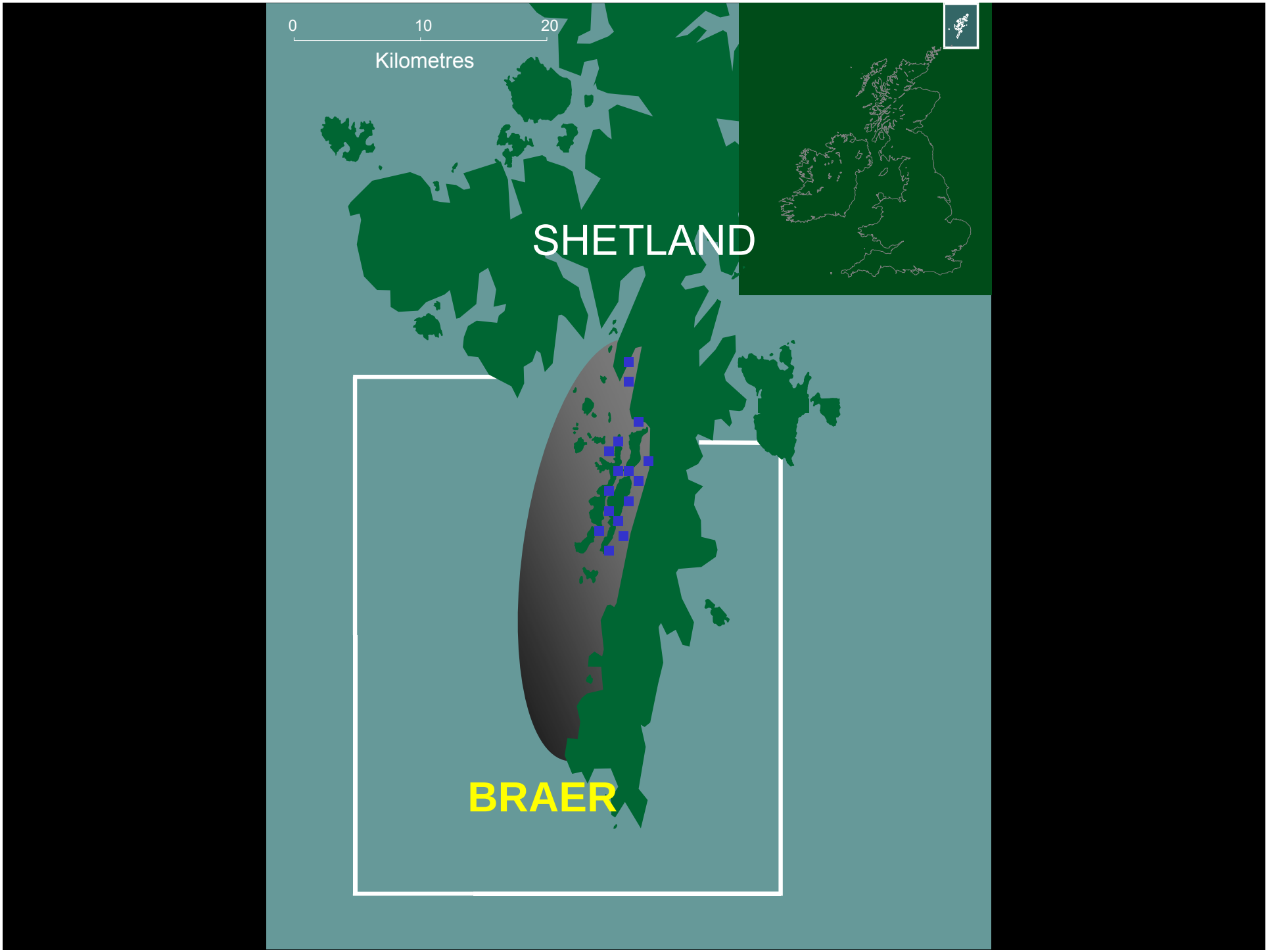
- Water quality testing
- Fish & shellfish analysis
- Taste testing
- PAH Analysis
- Oil fingerprinting (GCMS)

POLYCYCLIC AROMATIC HYDROCARBONS

- 3- to 7-ring PAH include known carcinogens
- Pyrogenic and petrogenic sources
- Exposure to PAH is primarily from food
- PAH present in many non-marine foods
- Background levels of 5-50 ppb in seafood
- PAH from oil spills not a significant threat to public health (GESAMP 1993, EPA 1997)

POLYCYCLIC AROMATIC HYDROCARBONS

“From a strictly medical standpoint, there is no historic oil spill-related incident that can be held up as justification for regulating public seafood consumption” (GESAMP)


0
10
20
Kilometres
SHETLAND
BRAER

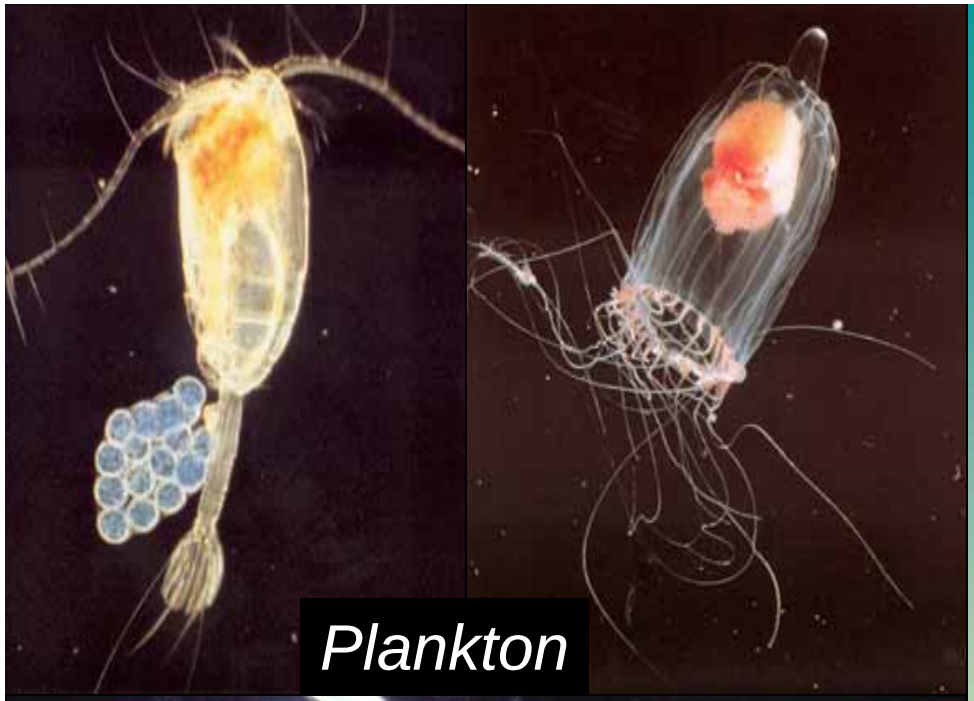
PAH IN SHELLFISH AND OTHER FOOD

[CPAH] = Sum of main potential carcinogens

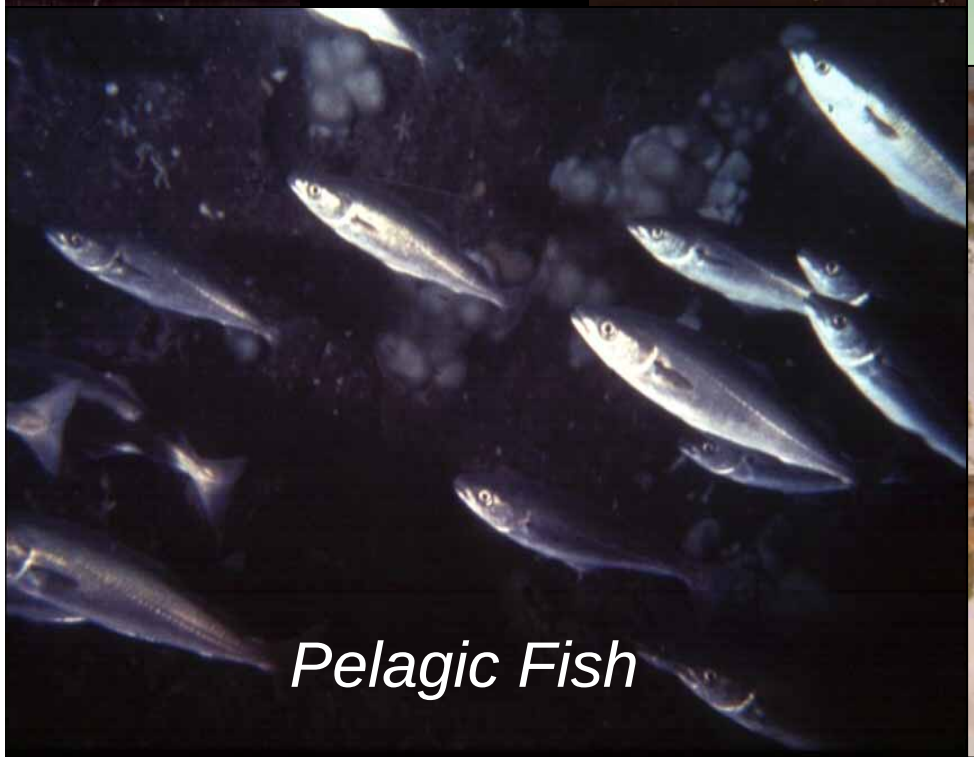
FOOD ITEM	[PAH] ng/g	[CPAH]
Post-BRAER oil spill, Jan '93		
lobster meat	11 - 1,060	2.6
scallop muscle	223 - 3,580	10.9
scallop gonad	90 - 20,800	6.8
Unoiled reference samples		
lobster meat	3 - 25	
scallop muscle	13 - 289	
scallop gonad	26 - 2,030	
Barbecued & smoked food		
barbecued beef	42.1	30
barbecued pork	13.6	6.5
pizza in wood-fired oven	13.1	12.3
kiln-smoked mackerel	54.2	1.5

Role of Science

- International compensation regime
- Fisheries and mariculture
- **Environmental impact & restoration**
- Wider perspectives



Plankton



Pelagic Fish

The Open Sea

- Dilution usually rapidly reduces oil concentration
- Effects on plankton well known but appear to be transient
- Effects on adult communities rare except in really large spills

Benthic Communities

Environmental Monitoring

Intertidal and sea bed sediments

act as a reservoir for contaminants

SELENDANG AYU

Aleutians, 9 December 2005

70,000 tonnes Soya bean

1,800 tonnes Heavy Fuel Oil

70 tonnes Marine Diesel Oil

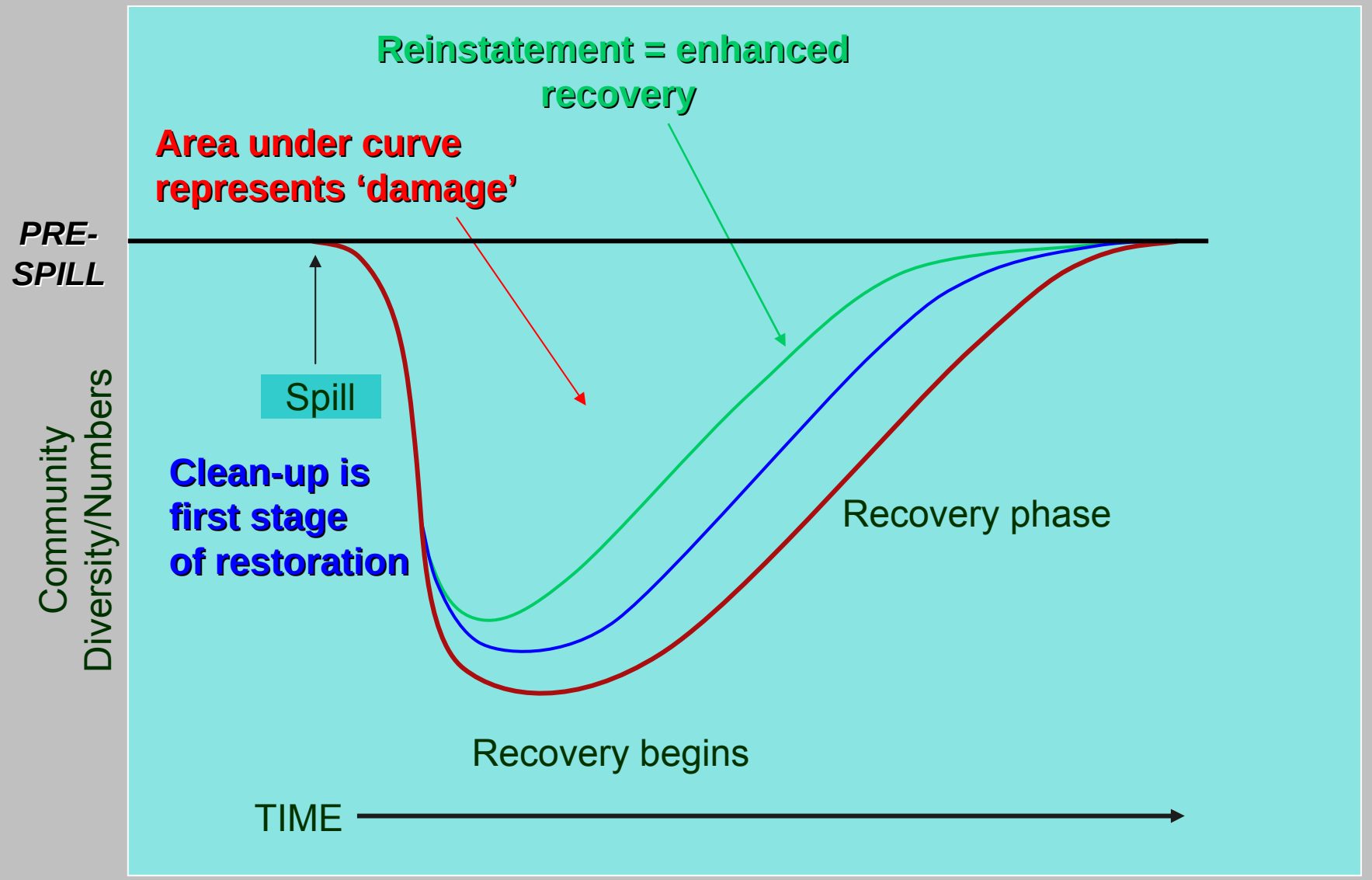

05/02/2005

Reinstatement Measures

"To re-establish a biological community in which the organisms characteristic of that community at the time of the incident are present and are functioning normally…."

- **Measures should enhance natural recovery and / or prevent further injury & pollution damage**
- **Measures must be feasible and reasonable**
- **Costs must be actually incurred or committed**
- **Measures may be taken at some distance from damaged area if it can be shown they would enhance recovery of damaged components**

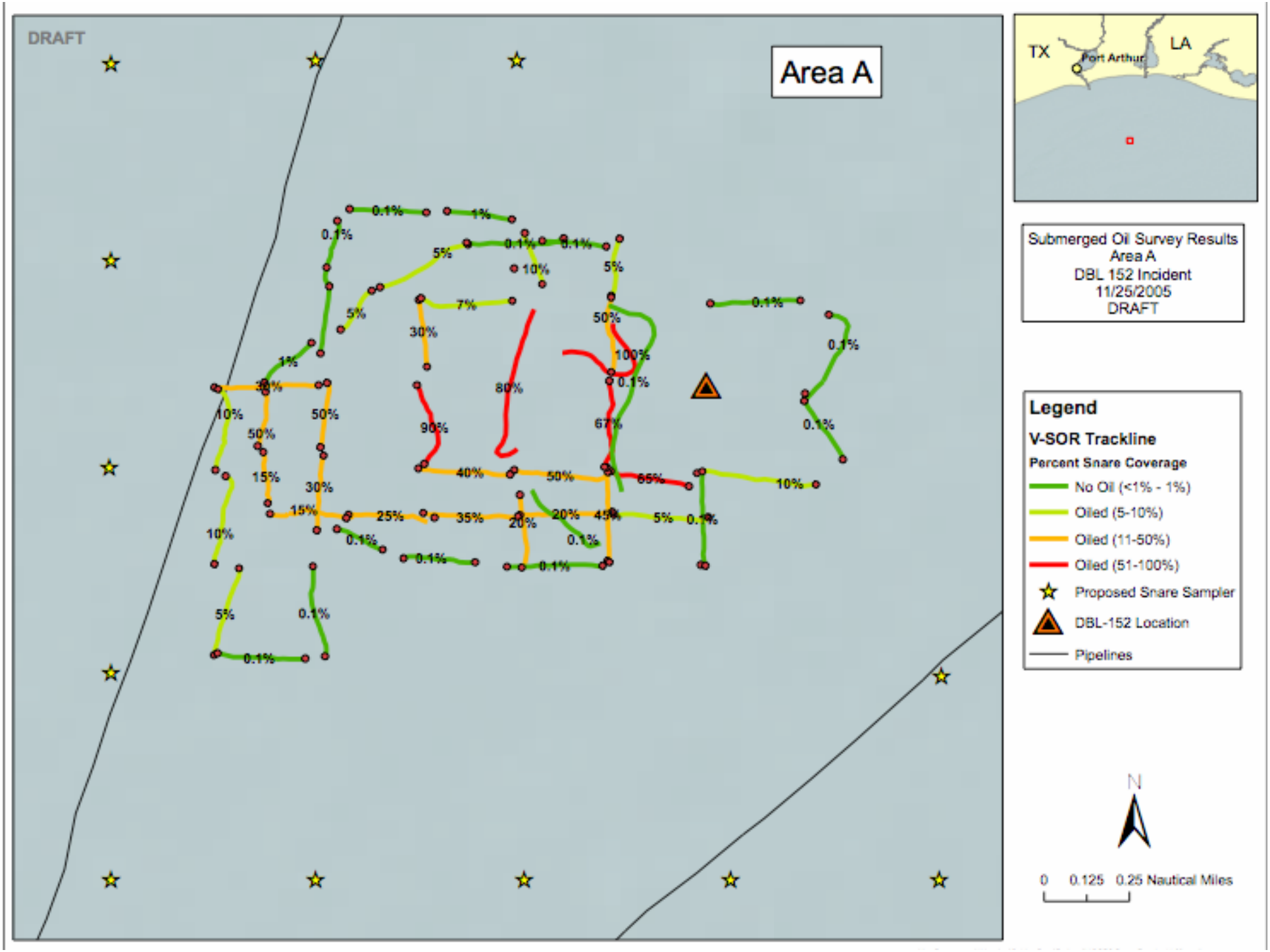
Scope for Restoration



Transplanting to repair damage

POST-SPILL ENVIRONMENTAL STUDIES

- Promoting co-operative environmental monitoring
- Selecting experts & appropriate techniques
- Establishing terms of reference
- Avoiding unnecessary repetition of other work
- Studies should be practical and deliver relevant data


DRAFT
Area A
TX
LA
Port Arthur
Submerged Oil Survey Results
Area A
DBL 152 Incident
11/25/2005
DRAFT
Legend
V-SOR Trackline
Percent Snare Coverage
No Oil (<1% - 1%)
Oiled (5-10%)
Oiled (11-50%)
Oiled (51-100%)
Proposed Snare Sampler
DBL-152 Location
Pipelines
N
0 0.125 0.25 Nautical Miles

Typical Problems

- **Poor organisation and co-operation between interested parties**
- **Weak rationale for conducting studies**
- **Flawed data and loss of time**
- **Suppression of data**

Typical Problems

- **Data gathered by scientists**
- **Results interpreted by economists**
- **Claim negotiated by lawyers**
- **Settlement challenged by public**

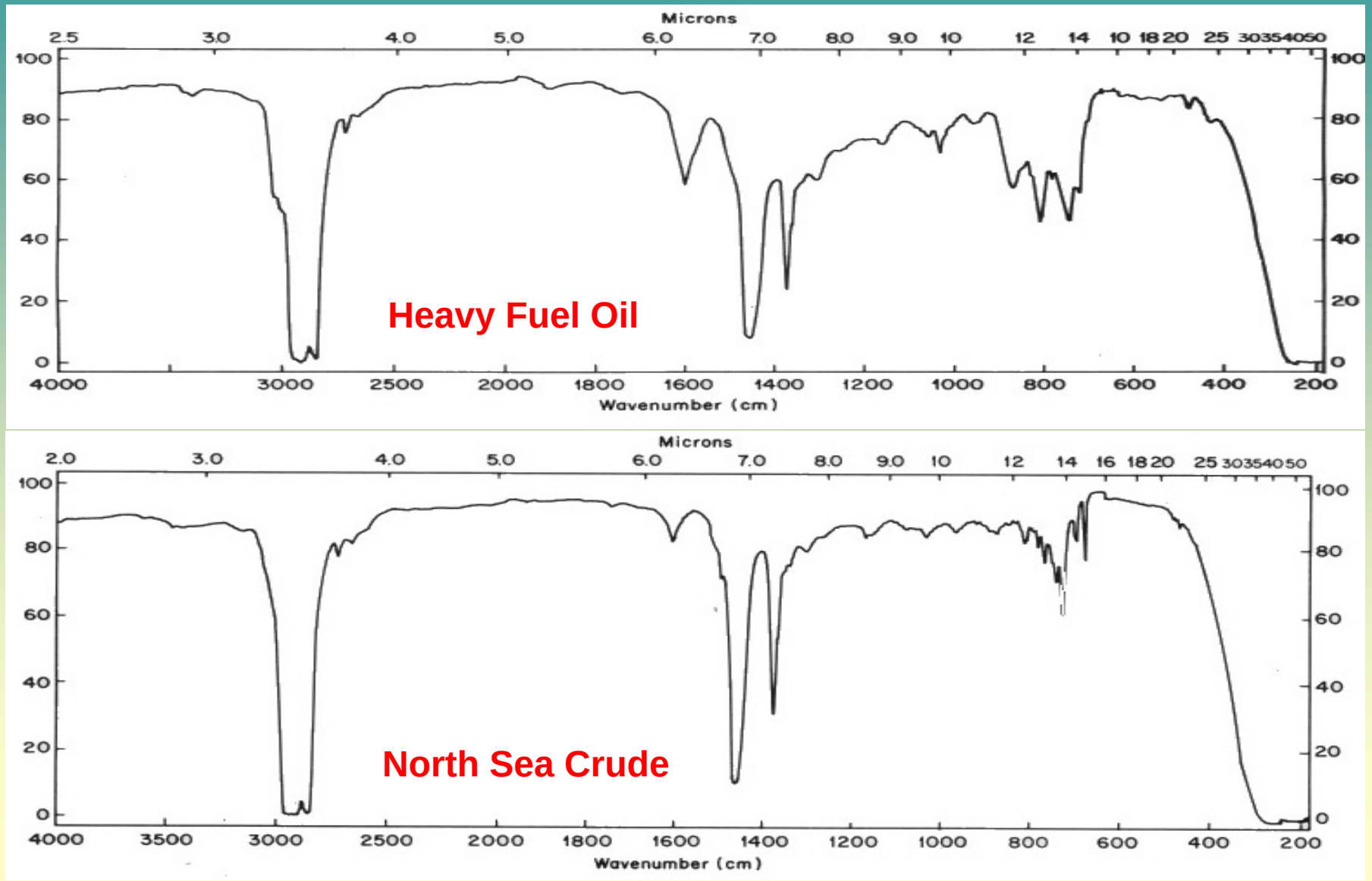
US OPA 90 - NRDA

“Science seeks to establish the scientific truth whereas the legal process is founded on the advocacy of conflicting interests to resolve a truth”

(The Use and Misuse of Science in NRDA, IOSC, 1995)

IR Spectroscopy of Heavy Fuel Oil & North Sea Crude

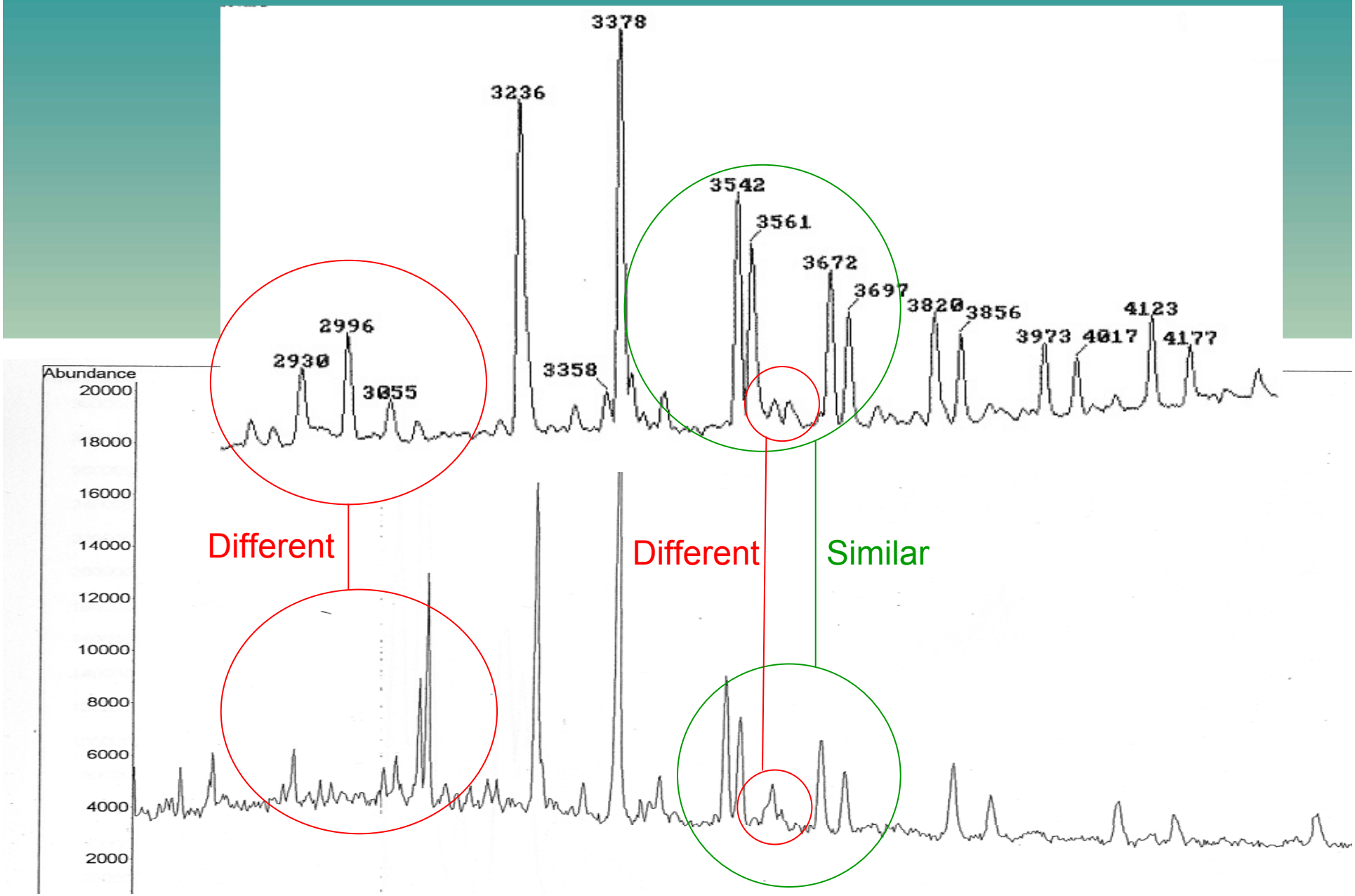
重燃料油和北海原油的IR光谱轨迹



IR and UVF oil analysis

- Both were early analytical methods for oil developed in the 1960's - 1980's
- Both methods are compromised by natural organic compounds and other pollutants, giving false results
- IR and UVF techniques be used for oil monitoring, but need to be carefully calibrated as they are imprecise
- Neither IR nor UVF now generally accepted for detailed oil identification. Many crude oils give similar 'fingerprints'

GC-MS Trace (Ion 191) of Iranian Light & Heavy Fuel Oil



Improving response

- **Minimising delay in sample collection & analysis**
- **Documenting procedures to be used**
- **Identifying key facilities, resources & personnel**
- **Harmonisation of methods**
- **Integration with other contingency plans**

Baseline vs. Reference

- **Baseline data gathering in advance of a spill**
- **Sourcing of available data**
- **Post-spill sampling ahead of spreading oil**
- **Sampling at un-oiled reference sites**

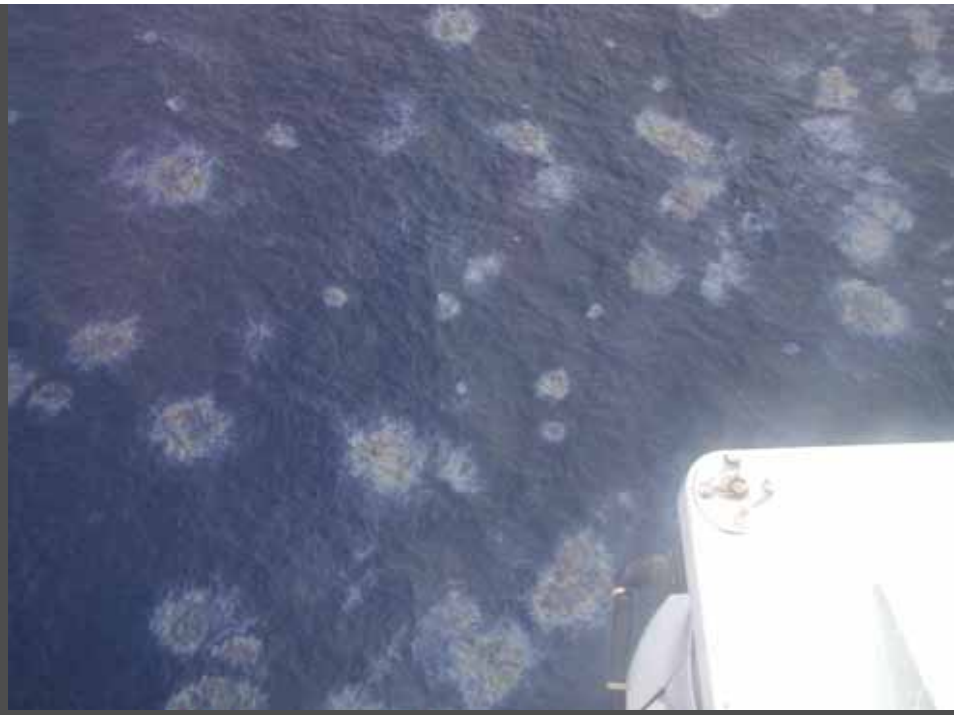
Role of Science

- International compensation regime
- Fisheries and mariculture
- Environmental impact & restoration
- **Wider perspectives**


Marine pollution
Sewage, eutrophication, algal blooms, health threats
Classic pollution (metals, oils, organics, radionuclides)
Endocrine-disrupting chemicals
Man-made debris (litter)
Ecological balance
Destructive fishing practices
Reduced biodiversity
Transfer of alien species
Group of Experts on the Scientific Aspects of Marine Environmental Protection
Habitat change
Climate change, sea-level rise & coastal flooding
Marine habitat destruction (coral reefs, mangroves, wetlands)
Deforestation & changes in hydrology, turbidity, sedimentation
Mineral, sand & gravel extraction

Oil in Wrecks

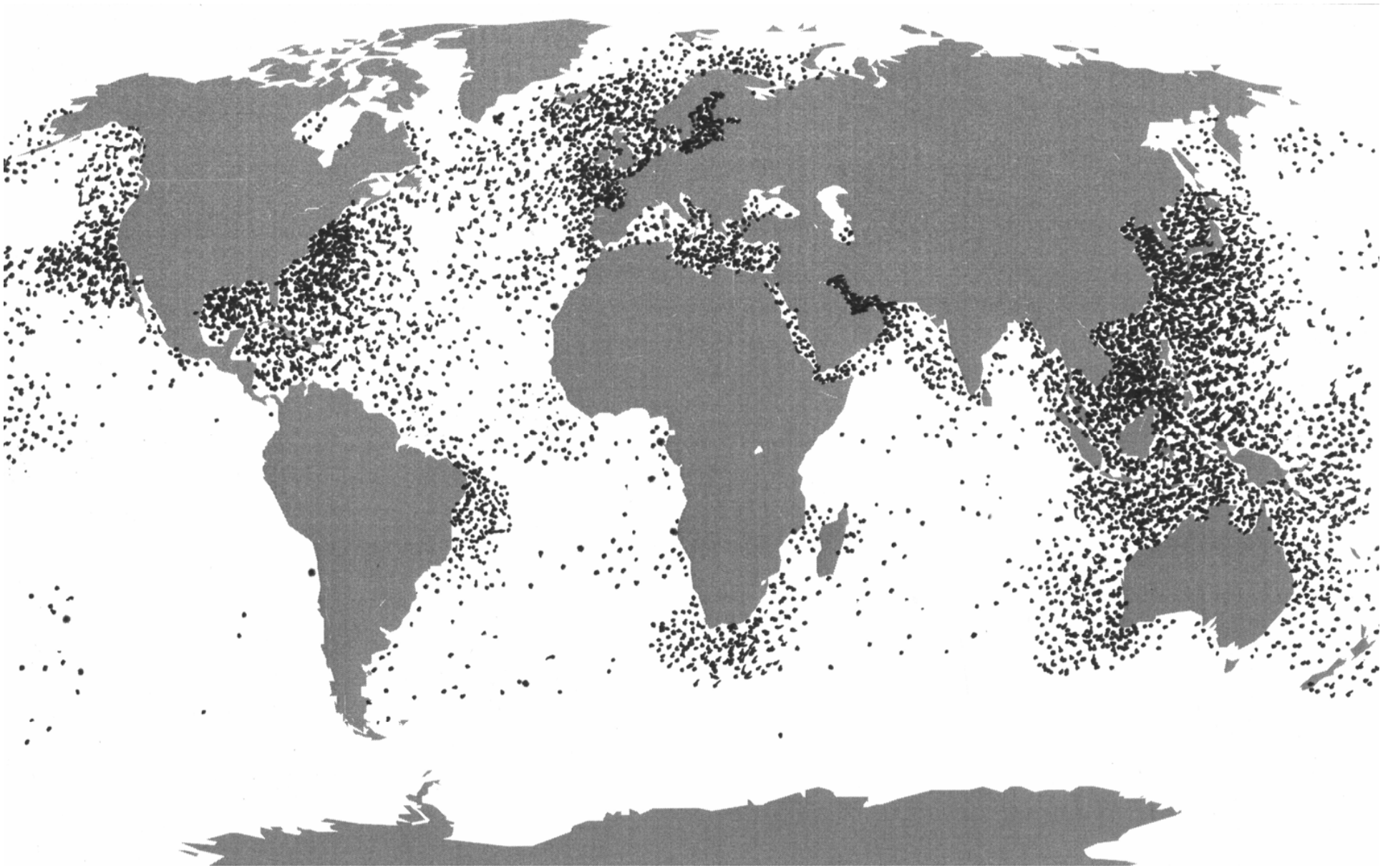
Stern at 3,830 metres; Bow at 3,500 metres



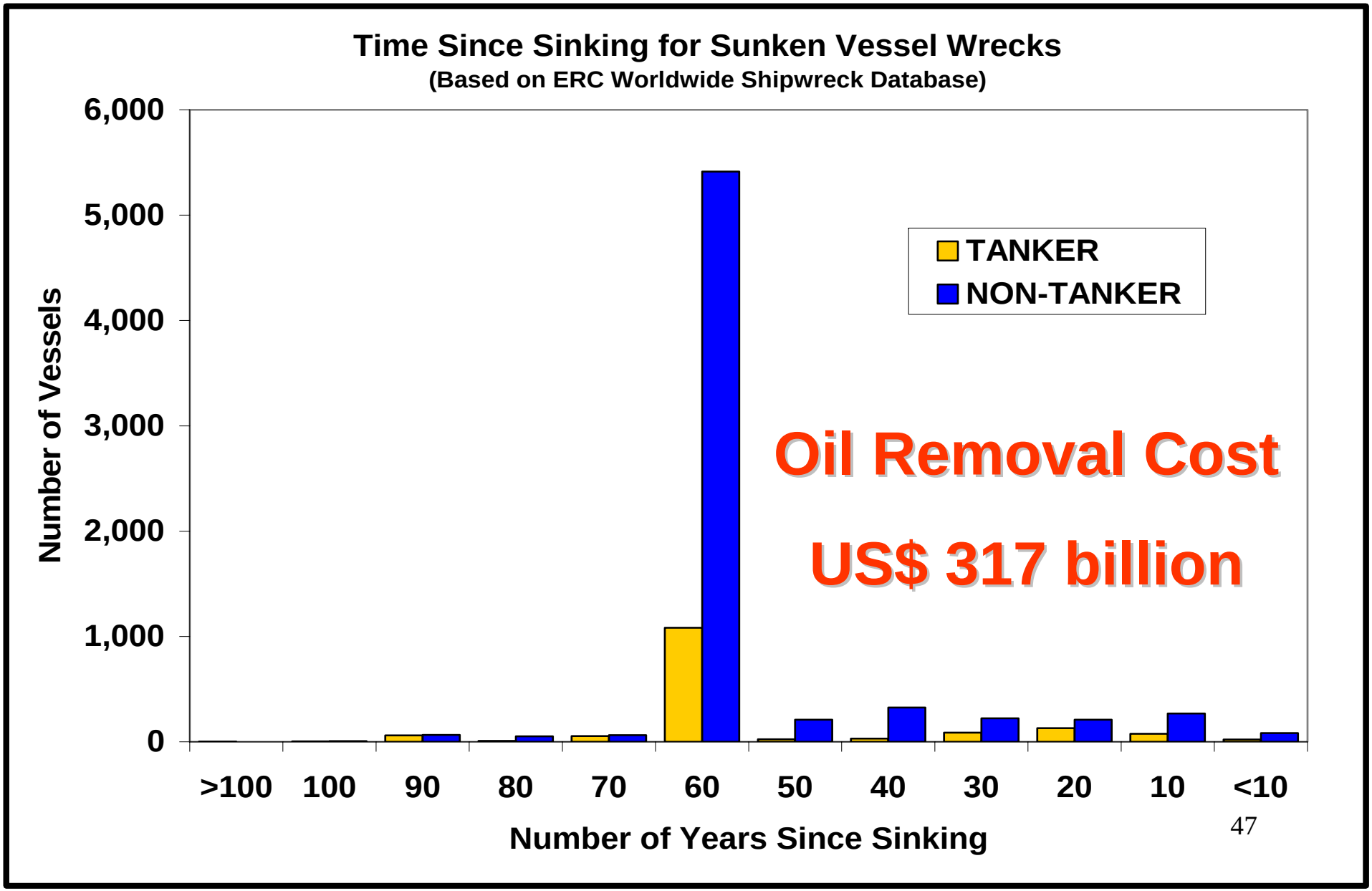
Removal of oil from PRESTIGE wreck

- **Minisub dives to inspect & plug leaks, 2002**
- **Trials in Mediterranean & Atlantic in 2003**
- **Completion in autumn 2004, 13,000 tons removed**
- **Total cost €111 million to Spanish government**
- **Most IOPCF delegations considered costs to be disproportionate to benefits gained**

8,569 wrecks with 2-20 million tonnes of oil



8,569 wrecks with 2-20 million tonnes of oil



IOPC Fund's Proposed Guidelines: removal of oil from sunken wrecks

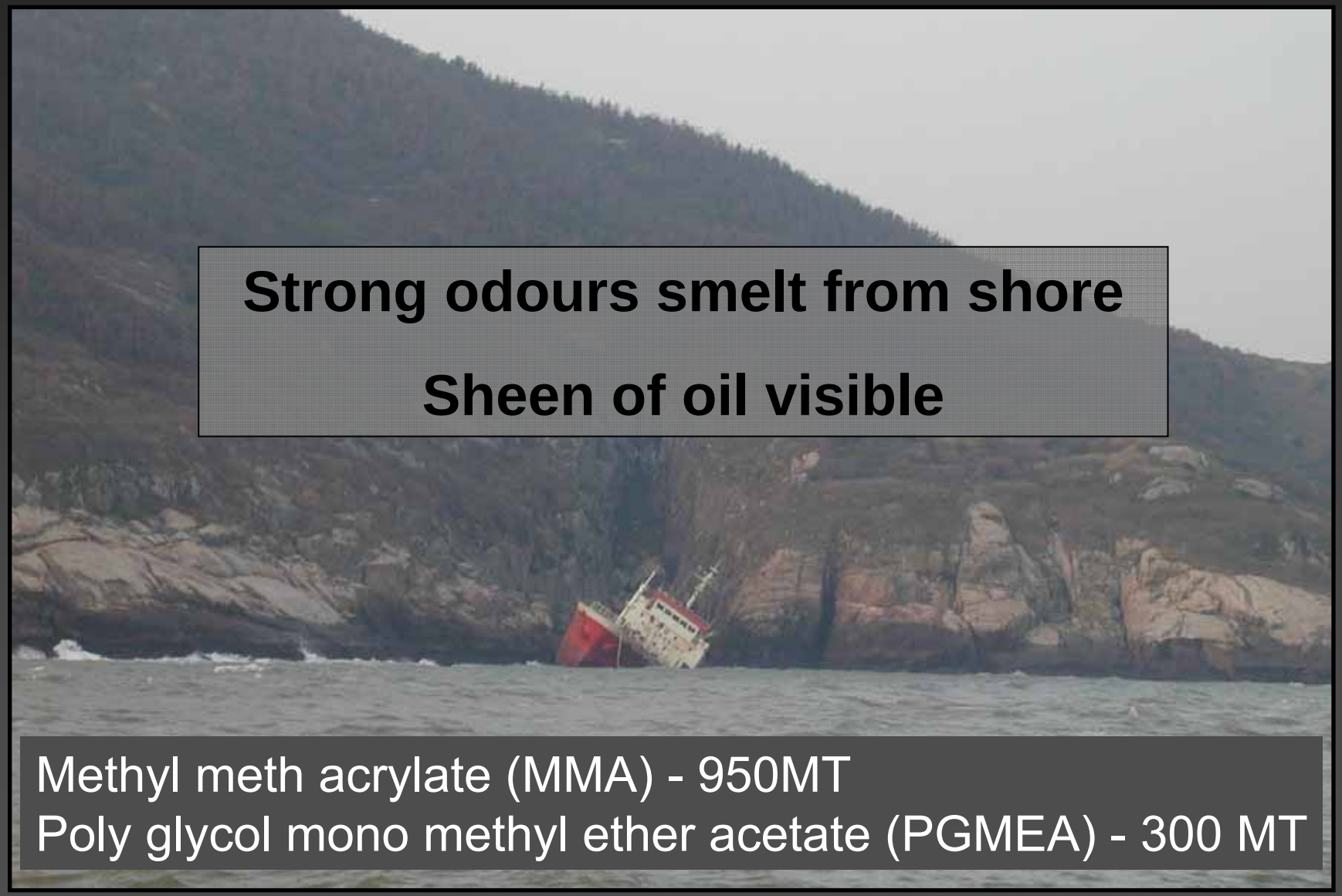
1. Proximity of vulnerable shoreline & probability of economic damage if oil released
2. Risk of environmental damage, costs of post-spill studies & reinstatement
3. Likelihood that oil will be released, rate of release and its movement & behaviour
4. Alternative methods
5. Costs of removal and likelihood of success
6. Risk of release during extraction operations

Simplified draft admissibility criteria applied to PRESTIGE & SOLAR 1

Factor	PRESTIGE	SOLAR 1
a) Risk of economic consequences	Low	Moderate
b) Risk of environmental consequences	Low	Moderate
c) i] Likelihood of oil release, and ii] risk of oil reaching sensitive resources	Low Low	Uncertain High
d) Alternative approaches	Considered	-
e) i] Costs and ii] likelihood of success	High High	Moderate High
f) Risks of release during extraction	Low	Low

ACCORD

Yangtze River, Shanghai, China, 19 October 2002



Methyl meth acrylate (MMA) - 950MT
Poly glycol mono methyl ether acetate (PGMEA) - 300 MT

ACCORD

Yangtze River, Shanghai, China, 19 October 2002

HAZARDS

MMA (950MT)	PGMEA (300 MT)
Highly flammable liquid	Flammable liquid
Does not dissolve in water	Dissolve in water (main behaviour)
Rapidly evaporation	Evaporation
Toxic Inhalation TLV = 50ppm IDLH = 1000ppm	Practically non-toxic to marine life
Worst case scenario sudden release of 950t cargo human health concern < 5 km downwind	

ACCORD

Yangtze River, Shanghai, China, 19 October 2002

ECE,
Cherbourg, France , 31st Jan 2006

- Phosphoric acid - 10,361 MT
- IFO 180 & MDO - 84 MT
- Lubes - 22 MT

RESPONSE

- ROV survey done by shipowner
  - Massive damage, implosion of empty wing tanks

RESPONSE

- For 15 weeks authorities required seawater samples to measure phosphate levels
- Levels were above background but did not raise environmental concerns
- Concern of algal blooms
- Environmental groups were concerned of the presence of heavy metals and uranium

FATE OF OILS & CARGO

- Substantial proportion of oils & cargo thought to be lost
- Possibility that cargo remains in one or more tanks
- Slow release, openings & eventually corrosion
- Measured levels of phosphate too low to cause localised acidity
- Computer simulations show potential for only very localised impact even with substantial loss
- Slow natural release provides best environmental option

Conclusions

Methods for Assessing Oil Spill Impact on the Marine Environment

- Marine pollution in context – does it matter?
- Proportional principle
- Role of science: credibility and consistency