DETERMINING THE PRIORITIES FOR POST SPILL STUDIES

Loïc Kerambrun, Franck Laruelle & Ivan Calvez
Centre of Documentation, Research and Experimentation
on Accidental water pollution (Cedre)
Brest, France www.cedre.fr
loic.kerambrun@cedre.fr

Abstract
Analysis of environmental monitoring programmes for oil spills highlights the need felt by both the scientific community and decision-making and financial organisations for a comprehensive approach to a general policy for programmes to assess impacts and provide ecological monitoring. This would serve, in the case of an oil spill (i) to quickly decide (without losing time or information) what should be monitored, how and to what end, (ii) to coordinate and harmonise the preliminary research and measures required, and (iii) to assess the framework to be created or joined, where these measures can be implemented as realistically as possible in terms of human, technical and financial resources. Priorities in terms of environmental monitoring can be drawn from lessons learnt from previous oil spill experience.

Oil spills are usually followed by a programme to assess their ecological impact, which will obviously vary with respect to the characteristics of the pollution (its scope, the type of pollutant involved) and those of the affected shore (its aspect and exposure, its ecological richness and sensitivity, economic uses, etc.).
When we compare the programmes set up for various accidents, we also see that even for pollutants and coasts which seem quite similar at first sight (especially the coasts of North-western Europe), the same approaches are not systematically adopted.
Various parameters can explain this variability: the way the monitoring programme is managed (i.e., the source and terms of funding, the coordination's structure), the state of knowledge of the environment or habitat (and the oil's impacts), the amount of interest shown for the different environmental compartments affected, the availability of research scientists, the objectives sought, etc.
Whenever there is a significant oil spill, the scientific community hopes to rapidly obtain the funds needed to assess the impact of the pollution, from authorities or from the polluter. On their side, the authorities want to respond to the public's justified concern, and this public thinks that scientists have the appropriate means to make this assessment.
But do scientists really have such *ad hoc* resources at hand? If not, what is missing? How should the gaps be filled? What should take priority in improving the ecological monitoring scheme? What can we learn from past experience?
To provide some elements of response to these questions, the Cedre has analysed the management aspects (i.e. financing, implementation, etc.) and technical procedures (i.e. approaches and protocols) of programmes to monitor ecological impacts of major disasters:

- first of all by getting feedback about the monitoring of pollution from the Amoco-Cadiz (1978), through a survey conducted in 1997 – some twenty years after the accident- with French scientists who were involved at the time;
- more recently, in 2004, through a comparative study focusing on 6 major oil spills occurring in Europe or North America;
- and lastly, in 2005, by organising a European seminar on monitoring of the benthic environment.

Feedback on how the ecological monitoring programme for the Amoco Cadiz pollution (France, 1978) was set up.
In 1978, the Amoco Cadiz tanker spilled its entire cargo, i.e. 220,000 tons of light crude, over nearly 350 km of the northern coastline of Brittany in western France. No country had ever experienced such a disaster and knowledge in terms of environmental impact and recovery were extremely limited at the time. The Amoco Cadiz was clearly the first oil spill to undergo true ecological monitoring taking the different environmental compartments into account.

In 1997, for the twentieth anniversary of the disaster, the Cedre evaluated this monitoring programme on the basis of interviews (a dozen stakeholders at the time: 9 scientists and 3 elected officials) and a questionnaire sent to some thirty French scientists who had taken part in the monitoring (half of whom replied). At the time, scientists and politicians, swept up in the emergency, had to improvise in designing an environmental monitoring programme. The main objective in getting this feedback was to determine the strong points and what the scientists felt was lacking or needed at the time.
The questionnaire was mainly structured around the following themes:
- « *How did you proceed and would you do the same now? What was lacking and what is needed?* ».
The main results of this study were as follows.

- *What protocol to use?* Scientists implemented the procedure they usually used for a survey in a context other than oil, with some possible adaptations in view of the pollution and the emergency situation. In the case of future similar spills, most of them would use the same protocol (except any now-obsolete procedures) and, to take into account any new relevant methodologies or tools, would add some set-ups and monitor physicochemical parameters or indicators now assumed necessary for an ecological survey, as well as carrying out complementary ecotoxicological studies. Some scientists mentioned their interest in using pre-defined procedures aiming, amongst other things, at comparison of results.
- *Why did they stop?* The main reason was the end of funding and also because there was evidence of ecological recovery. But it also became difficult, in some places, to differentiate the impact of Amoco Cadiz crude oil from further pollution effects (from land – eutrophication - or from the Tanio tanker spill in March 1980).
- *What was lacking*? Principally, baseline reference data and knowledge about natural ecological fluctuations were felt to be lacking.

This first study enabled the following perspectives and recommendations to be drawn:

- improve knowledge on re-settlement and recovery processes (by carrying out prior studies on biological cycle (species), populations dynamics, etc.);
- build baseline reference data (pre-spill studies) and also use ‘contemporary reference data’ (i.e. control and/or unspoiled, similar sites nearby);
- facilitate multidisciplinarity and improve collaborative work to avoid gaps or discontinuities between monitoring studies (e.g. intertidal / subtidal; chemical/ biological/ ecotoxicological) and better assess the effects of the disappearance of species or groups within the food chain;
- define the objective(s) of the programme studies: (i) To show that an impact exists? (ii) To quantify the impact? (iii) To rank the impact with respect to severity / resilience? (iv) To provide arguments for whether or not to clean an area, or to stop clean-up operations? (v) To draw up a case for compensation? etc.
- provide better coordination of the studies; create a national scientific steering committee (similar to what was done in the UK during the *Braer* and the *Sea Empress* spills) including scientists (with oil spill knowledge or training) and representatives of ministries involved in environmental aspects and in research. Acting both inside and outside of crisis time for : (i) Coordination of preparative work, (ii) Activation of an operational committee (to be part of the decision-making process) (iii) Management of the environmental impact monitoring programme (coordination, recommendations, guidelines, valorisation)
- carry out a comparative study on environmental impact assessment programmes defined for other black tides;
- use predefined procedures and protocols (i) which are standardised or widely accepted by scientists, on national or international levels, (ii) adapted to pollution features (size, type, etc.) and to the aim of the programme
- in order to better assess interspecies competitiveness (a key factor in restoration processes), monitor populations rather than a single species;
- in order to limit errors of analysis, keep the same protocol throughout the monitoring, choose protocols not likely to become too unwieldy in the medium or long term, maintain the same sampling effort, and when possible, keep the same operators for sampling as well as for species sorting and identification.

The Amoco Cadiz experience contributed greatly to improving knowledge of the phases and processes of contamination/decontamination, impacts and ecosystem restoration. To what extent was this experience turned to good account during the subsequent oil spills which took place in France?

Feed back on managing ecological monitoring programmes (France).

If we compare what was set up during the Amoco Cadiz (1978) with what was later in France during the Erika disaster (1999) and then that of the Prestige (2001), great variability over time in the same country is seen in terms of environmental monitoring programme management.

In 1978, the need to evaluate the ecological impact of pollution from the Amoco Cadiz was immediately felt by the scientific community, public authorities… and the polluter. Indeed, the French government, followed by the American Amoco firm, quickly made the necessary funds available. As of the second day following the accident, the French ministry in charge of the environment had defined the coordination structure of a 3-year national ecological monitoring programme which was financed to the tune of 4.3m FRF. Concurrently, the Amoco contributed 2 million dollars (i.e. about 8.06m FRF) to the US *National Oceanographic and Atmospheric Administration* (NOAA) to carry out a complementary Franco-American programme. Several French universities and scientific organisations took part in this programme alongside the American teams.

Study results were quickly published through seminars (T+3 months, T+12 months and T+30 months) and summary publications (at T+12 months and T+20 months). Beyond 1981, funding stopped and studies became fewer and far between. Only a very few laboratories continued their monitoring over a longer period.

Over twenty years later, following pollution by the Erika, the environmental monitoring programme (with an additional ecotoxicological strand) was organised in a very different way. The scientists hesitated to mobilise their forces while awaiting financing, and the authorities' response was less spontaneous: the first official decision was taken 2.5 months later and the programme officially launched at T+1 year. Dissemination of study results also came much later: the first conference was held at T+2 years and another at T+4 years.

In comparison, let's consider what happened in the meantime in the United Kingdom. British scientists and authorities had the opportunity to set up environmental monitoring programmes, one in Scotland and the other in Wales, following the Braer (1993) and Sea Empress (1996) spills. UK government established steering committees to oversee the impact assessment of these two oil spills: the Ecological Steering Group on the oil spill in Shetland (ESGOSS) and the Sea Empress Environmental Evaluation Committee (SEEC). These were exemplary programmes in terms of how they were organised, the time needed to set them up (respectively T+20 days and T + 40 days) and in the return of results (respectively T+3 months then T+1 year, and T+4 months then T + 2 years).

Two years after the Erika, came the Prestige spill (2001) on the Spanish coasts, and less intensively, on the French coast. The French ministry in charge of ecology decided not to open a specific environmental monitoring programme for the Prestige (in fact, no study was officially proposed by scientists), finally preferring to launch two other programmes of another type (begun in 2005): one involved the setting up of lasting coastal observatories (with the hope of filling in some of the gaps with respect to baseline data) and the other the economic assessment of ecological damage.

Comparative analysis of ecological monitoring programmes

In 2002, the *Cedre* starting taking stock of environmental monitoring carried out following major oil spills: Amoco Cadiz (France, 1978), Exxon Valdez (1989, USA), Aegean Sea (1991, Spain,), Braer (1993, UK), Sea-Empress, (1996, UK), Erika (1999, France). This comparative bibliographic study aimed to take an inventory of approaches, targets and protocols used to monitor the impact in various coastal compartments. The end purpose of this study, in scientific terms, was to identify the targets and protocols which were used either systematically or very often; and in operational terms, to highlight the elements which could optimise scientific organisation before and during the crisis.

Besides identifying the five ecological domains to be particularly investigated following an oil spill (terrestrial, benthic intertidal, benthic subtidal, pelagic, marine mammals, birds), and three types of approach (contamination, biology, ecology) implemented at various organisational levels, the study provided an inventory of targets and methodologies used within the different approaches, and

discussed the justifications of these choices as well as the availability of reference data, variable among the cases. Some of these results were presented by Laruelle & Calvez (2005).

A European seminar on Ecological Impact Assessment

In the wake of the above-mentioned study, the *Cedre* organised a conference on 12-14th October 2005 in Brest (France) entitled "*Ecological Impacts of Accidental Marine Pollutions on the Benthic Environment: Assessments and Prospects*". Including round table sessions, this event allowed discussions about lessons learnt and the current points of views regarding the benthic effects assessment studies. Lectures and round-table conclusions are available on the Cedre web site (http://www.cedre.fr).

From the Braer and the Sea Empress experiences, R. Law highlighted, amongst others, the interest of existing reference baseline data and insisted on the need for coordination of studies and sampling, and an overview of the results. From lessons learnt in the framework of the Marlin programme, K. Hiscock reminded participants of the interest of time-series. He also mentioned, inter alia, that change is often not synchronous between sites that are similar in character (making it difficult to identify 'reference' sites) and that 'change' itself may be an artefact because the scale of natural variability is often smaller than the scale of between-worker variability. Laruelle and Calvez presented both the study previously mentioned and its main findings about the benthic environment. Girin and Dicks set out national and international points of view regarding the assessment of environmental damage (notably in terms of compensation).

Four round-tables were held during this technical seminar. The main findings are presented below (as they were validated during the seminar).

- *« Is the existing situation satisfactory ? »:* the first round-table concerned what is considered to be lacking or needed.

Reference data

- Rapid access to pre-spill data and information about where it is available, since baseline data availability is a key point. Data obtained from long term monitoring/survey programmes and the Water Framework Directive (WFD) are necessary and useful (time series) but not sufficient to assess oil spill perturbations in benthic structures. It is thus necessary to act rapidly during the oil spill's initial phase to carry out studies and assess initial mortalities.
- Well known recovery processes demonstrate a return to a functionally restored system after time, which is not necessarily identical to the pre-spill situation (species composition). At this stage, it may be difficult to distinguish the oil spill's effects from other constraints (chronic pollution, eutrophication, global change, etc.).

Key indicators

- There is a European agreement regarding the use of sensitive taxa for impact assessment (WFD).
- There is a general consensus about using fine sediments as a key habitat (tidal and subtidal). Testing and interpretation is needed for the identification of key indicators in rocky communities (recent review for the WFD and definitions are available on the *MarLin* website).
- Impacts on complex (highly diverse) and natural heritage habitats (maerl and seagrass beds, amongst others) within an area affected by an oil spill should be assessed.

Programme management

- More co-ordination and multidisciplinary studies (crossed approaches) at common sites are needed.
- There is a general consensus about decreasing availability of taxonomic skills among marine biologists, especially in the near future. Even though some general perturbation/restoration patterns after an oil spill have been well documented, impact assessment strategies and methods should be adapted rtegarding the ecological and pollution context.

- *" What methods for what objectives?"*: the second round table addressed the approaches and targets which can be considered.

Species to select

Any or all of the following : (i) Indicator species that are known or thought to be sufficiently abundant in the area, (ii) Significant species of nature conservation importance -e.g., from the Red List, Biodiversity Action Plans, etc. (preparatory work should be undertaken in preparing species lists in

countries where this has not already been done), (iii) Key functional or structural species, commercial species, (iv) Sensitive species which will be adversely affected.

Other considerations

- Local knowledge is important as an input to the species selection process. An understanding of the biology of the selected species (breeding cycle, etc, in order to be able to predict recovery and explain physiological changes, the bioaccumulation process, etc) is needed.
- Species checklists could be generated for initial rapid surveys of gross impacts, but this must not be proscriptive, especially in more detailed or longer term studies (for rapid surveys, suggested photographic documentation of sites and « how-to-do-it » briefings).

About biomarkers

- It is very important to distinguish between biomarkers of exposure and biomarkers of impact.
- Biomarkers provide a biological signal of effects within the organism, but extrapolation to the whole individual, population, community level is extremely problematic (e.g. determining PAH metabolites quantifies exposure and DNA-adducts shows a potential impact, but currently they cannot be linked to the incidence of cancer).
- For many biomarkers, there are other compounds than our target compounds which induce a response (e.g. combustion vs oil PAH; Aryl hydrocarbon hydroxylase/EROD). So, the question is: *can we use biomarkers to quantify spill-induced effects, or only use them to define the area in which organisms have been exposed to contaminants ?*
- Biomarker studies are complementary to other effects studies. Cause-effect relationships may not be clear (linked to the lack of specificity of many biomarkers, responses to environmental conditions, physiological changes unrelated to the spill, and so on).

- The third round table "What methods for what objectives?" aimed to assess the degree of accuracy required with respect to objectives.

Drivers

There is a wide variety of drivers (political, practical, scientific etc.), which leads to a wide range of objectives and approaches. Interests can vary but are not conflicting.

Objectives

Objectives might include providing authorities with relevant and scientifically sound information enabling them to (i) inform the public, (ii) get a swift and general idea of the extent of the impact, (iii) start or stop clean-up, (iv) avoid harmful (to aquaculture/fisheries and ecology) response techniques/options, (v) quantify the effects at different locations, and (vi) plan for the next spill.

Levels of precision and accuracy

- The level of precision depends on the type of involvement and the purpose: from the first the emergency (simple, rapid methods which give the first broad indication of extent of impact) to long-term monitoring (more detailed / quantitative / statistically robust methods to quantify impact and follow recovery).
- Whatever the phase of response, work needs to be undertaken accurately for identification species, quantification of numbers or extent, site location and maintainance of records. Quantification of impact includes studies of species abundance, extent of habitats (biotopes), biodiversity, biomass etc. The duration of the studies have to be adapted according to the progress of recovery.
- During the scientific response to the emergency, a swift assessment of the potential effects on the shoreline is possible from knowledge that scientists already have about the ecological sensitivity of different habitats and species. From the rough first assessment, scientists can define the methods needed and where to conduct precise long-term monitoring (however, if local scientists with no previous experience of oil spills are recruited, some form of briefing will be needed. A pre-spill check list may be helpful). Pre-spill information about the biology of the area is needed to take advantage of previous knowledge of spill impacts (feedback) in order to plan appraisal methods.
- During the post-emergency phase, long-term monitoring will be planned after initial assessments and rapid surveys. It is likely to be at this later stage that methods used need to be statistically robust and include systematic, quantitative and carefully planned surveys.

- *« Funding of impact assessments » :* the last round table dealt with the financial aspect (funding and reimbursement) of monitoring programmes.

Funding of studies

- What sources? Funding comes and is expected to continue to come from central government (ministries in charge of Environment and Research) plus various other sources (regional authorities, the EU, shipowners, etc.). It is important that those sources co-ordinate their funding initiatives, to avoid duplication. Establishment of joint management (see UK) is recommended.
- What budget? Different spills will have different effects and no reference budget can be recommended, neither in relation to the quantity spilled nor in relation to the response costs. The necessary/reasonable budget can only be assessed on a case by case basis. Budget assessment may be an iterative process.
- What procedures / coordination ? Direct contracting with suitable laboratories/consultants for the various components of an impact study programme is preferable to open tendering on general terms. Contracts can thus be performed faster, with less risk that an essential study component would remain unimplemented.

To minimise delays, response plans should include emergency procedures for awarding impact study components. Pre-identification of ad-hoc laboratories/consultants could be envisaged. Pre-agreed unit prices could be of interest, in matters where unit prices would not be excessively quantum-dependent.

Environmental impact study cost recovery

- They are governed by CLC 92 and FC 92 for tanker spills and covered by national legislation until the Bunkers and HNS Conventions come into force.
- The Conventions provide a mechanism for a consistent approach to studies and funding. The IOPC Fund 'Claims Manual' provides guidance regarding admissibility of costs (see Fund website for manuals); all claims are subject to the test of 'reasonableness'. 'Reasonableness' is not very precisely defined and guidance in the claims manual is rather general. So far, there is no 'track record' of dealing with environmental studies claims under the Conventions.
- Cost recovery <u>likely to be ADMISSIBLE</u> under the Conventions includes (i) costs of environmental studies linked to quantifying economic damage (e.g. to fisheries) or reinstatement measures (ii) reinstatement measures undertaken at areas which are remote from the damage, if they are likely to contribute to recovery within the damaged area.
- Cost recovery <u>likely to be INADMISSIBLE</u> under the Conventions include (i) costs of studies conducted for purely scientific purposes or for public relations (ii) claims for Environmental damage calculated using mathematical models, even if based on scientific study data.

Other considerations

- studies should aim to establish a link of causation between damage and the incident;
- studies should be based upon reliable scientific approaches, preferably quantitative as well as qualitative;
- claims are considered on a case by case basis;
- advisory involvement of insurer/IOPC Fund experts in planning the studies is desirable;
- costs/funding may be agreed in advance under the right circumstances;
- agreement over joint studies provides a common set of data for all parties; this approach is likely to facilitate reaching agreements over damages and reinstatement measures.

Towards filling in the gaps: baseline states and guidelines

The lack of baseline data was a recurrent observation in the environmental monitoring programmes for the various accidents studied. It was baseline data which was most lacking for analysis of impact monitoring of these spills.

Without a baseline, it is difficult to quantify and interpret both impact and restoration. Only the return to a balanced state can be noted, without knowing whether it is a new balance or that of the initial state. It remains that returning to the initial state is obviously hardly conceivable; the proportion of population fluctuations and changes due to natural (climatic variations) and anthropogenic (land or sea based pollution) causes is too difficult to assess.

When pre-spill baseline data is not available, the possibility of using contemporary controls should be systematically analysed. This can be:

- either selective samples taken in all haste, before the progression of the black tide, if this is possible. This approach was used advantageously during the Amoco Cadiz spill by scientists from the University of Brest. Hundreds of control samples were collected by the scientists and by

dozens of students that they had managed to mobilise in the face of the emergency and train in basic sampling techniques;
- or comparable, unpolluted sites surrounding the polluted sector. They are assumed to have synchronously assimilated the same seasonal and general trophic changes as the nearby polluted sites, but their reliability can sometimes be questioned (see above).

Creation of pre-spill baseline data is something the scientific community strongly wants, but setting them up is not easy and involves a number of prerequisites:
- choice of the most relevant key indicators or targets (species/communities/habitats) which scientists must agree on;
- continuity (long term series) whose periodicity must be defined to enable fluctuations over time of species to be integrated (biological cycles, seasons and climate vagaries, overall environmental trends, such as warming, for instance);
- an ad hoc spatial distribution (to be defined) taking spatial fluctuations into account; and
- the resulting large-scale investment (in terms of time, staff and costs).

Baseline data can be integrated within existing networks like the national seawater quality observation network. A few countries have this sort of tool, mainly involving monitoring of chemical (water, sediments and flesh) and bacteriological quality, but very few of them have true observatories for populations. Long term monitoring of species or special habitats exist locally, as in the United Kingdom where they were used to advantage during the Sea Empress event (inner part of the Milford Haven estuary, or the isle of Skomer for example). In France, only one station of benthic macrofauna populations has been part of the national monitoring network since 1990. This station, for which data has been available since 1976, was in fact monitored in the framework of the Amoco Cadiz spill. Following the pollution from the Prestige, the French government decided to set up long-lasting coastal observatories. For now, 5 have been identified, but not all of them have been financed in all or in part. They focus on the physical-chemical quality of the environment (this corresponds to a strengthening of the existing national monitoring network for water, sediment and living matter), benthic communities (mainly using indicators and by probably including a project, launched in the wake of the Erika oil spill, of setting up a monitoring network of the benthic habitats around the Brittany coast: ReBent -see at http://ifremer.fr/rebent-), land-based vegetation (inventory and mapping of vegetation, especially that with a heritage value), birdlife (mainly in over-wintering areas), and coastal geomorphology (erosion). These baseline datasets will also make it possible to respond to other international initiatives such as the European Water Framework Directive.

Other lessons have been learnt from past spills. In some countries there are now documents which enable the authorities to guide the first actions to be taken in the case of an oil spill for environmental assessment and in order to optimise the programme.
In France, an "operation guide for ecological monitoring of accidental pollution" (Cedre, 2001) explains the aims and methods of designing, managing and carrying out an emergency monitoring programme and one for long term monitoring, without going into the scientific protocols required to achieve the various objectives listed.
Australia and New Zealand have technical manuals for undertaking monitoring for actual or potential marine spill responses. This document (AMSA, 2003) provides guidelines on the scope, scale and design of monitoring methods, but mainly for the so-called ‘type-1 monitoring’ (emergency monitoring, i.e. information of direct relevance to spill response operations) as defined in the two-class monitoring nomenclature developed in Australia and New Zealand, not specifically for the type-2 monitoring (i.e. scientific investigation, baseline (pre-spill) monitoring and post-spill monitoring).
Wales also now has a useful dedicated document providing a structured framework and guidance for assessment of damage to wildlife and natural habitats following an oil spill (Moore J. et al., 2005). This guide recommends a staged approach to an oil spill damage assessment, from oil monitoring and assistance, to oil spill response, to the long term damage assessment. Targets are more accurately defined with respect to the different shore habitats and resources.

Conclusion

Where do priorities lie for *post-pollution* studies?

What the authorities want is to be able to quickly set up a monitoring programme, find the resources to do so and avoid forgetting to take any action, particularly in the emergency phase, which they could be criticised for or which could be prejudicial. This means that preliminary organisation is required for the scheme (financing, management structure and objectives), lists of experts and expertise (researchers, laboratories) and guidelines or check lists methodically describing the various steps. All these aspects of a purely organisational nature are fairly simple on the face of it, providing that they have been previously defined in the contingency plans.

As concerns the scientists, apart from the financial aspect (and the contractual terms mentioned above), their availability may create difficulties: the supervisory authorities must define ad hoc procedures which would allow scientists to momentarily stop their studies underway to carry out monitoring which, for most, would not give rise to their being evaluated by their own hierarchies. We should also stress the fact that, due to preference given to other fields of research, in some key disciplines of ecological monitoring (like taxonomy, or benthic ecology) the number of positions to recruit research scientists and teachers is dwindling. Of course, that goes beyond the framework of oil spills, but nevertheless merits that thought be given, insofar as in the final analysis, the very feasibility of an overall assessment of an environmental impact could be called into question.

The monitoring itself remains. Baseline datasets are not the only things we need. Although we agree on the necessity of monitoring some compartments (sedimentary or rocky, infra- inter- and for the Erika, supratidal domains), we still must define (in accordance with the objectives set) is most relevant to be studied within these compartments, i.e. the targets, as well as the appropriate protocols.

As we can see, priorities for post-spill studies lie at different levels insofar as they must meet the needs of authorities and scientists, as well as the constraints of the monitoring itself. Most of these priorities must be carried out, either entirely or in part, before the accident. They are indeed part of the preparatory phase, based on what can be learnt from past experience.

The various studies carried by *Cedre* mentioned here were funded by *Cedre*, Total and with the support of the French ministry for Ecology and Sustainable Development.

In attendance at the 2005 *Cedre* seminar were M. Auffret (University of Brest, France) / A. Augusztinowicz (Golder Associates, Hongrie) / S. Bahé (VIGIPOL, France) / I. Calvez (*Cedre*, France) / I. Clémenceau (Regional Directorate for the Environment, Corsica, France) / K. Colcomb (Maritime Coast Guard Agency, UK) / B. Dicks (ITOPF, UK) / B. Fichaut (University of Brest, France) / F. Gentil (CNRS, Roscoff) / M. Girin (*Cedre*) / M. Glémarec (University of Brest, France) / J. Grall (University of Brest, France) / B. Guillaumont (Ifremer, France) / M. Guillou (University of Brest, France) / C. Hily (University of Brest Brest, France) / K. Hiscock (MBA, UK) / A. James (Ineris/Ifremer, France) / L. Kerambrun (*Cedre*, France) / A. Lallemand (French Navy Ceppol, France) / F. Laruelle (*Cedre*, France) / C. Lavigne (TOTAL France) / R. Law (CEFAS, UK) / J. de Maupeou (Regional Council of Vendée, France) / A. Meudec (University of Brest, France) / X. Novoa Rodriguez (CEPRECO, Espagne) / S. Parra (IEO, Espagne) / F. Poncet (*Cedre*, France) / J.L. Savereux (barrister, France) / F. Siorat (LPO) / A. Tucker (ITOPF, UK) / L. Vinas (IEO, Espagne).

References

Kerambrun, L. (1997). *Amoco Cadiz, 20 ans après. Appréciation des conséquences à long terme d'une pollution majeure.* Rapport *Cedre* n° R.97.44.C. 53 pp.

Girin, M. (2001). *Le suivi écologique d'une pollution accidentelle des eaux. Conception, gestion, et réalisation d'un programme de suivi*. Guide opérationnel. Centre de documentation, de Recherche et d'Expérimentations accidentelles des eaux (Cedre), 37pp.

Calvez, I. et Larruelle, F. (2004). *Analyse des protocoles de suivis de l'impact écologique d'une marée noire.* Rapport *Cedre* n° R.04.50.C. 262 pp.

AMSA (2003). *Oil Spill Monitoring Background Paper* and *Oil Spill Monitoring Handbook*. Prepared by Wardrop Consulting and the Cawthron institute for Australian Marine safety Authority (AMSA) and the Marine Safety Authority (MSA) of New Zealand. 29 pp + 166 pp.

Laruelle, F. & I. Calvez (2005). *Oil Spill moNitoring: Analysis of Similarities and Differences in Approaches and Methodologies.* ICES 2005 annual Science Conference, Aberdeen, Scotland, 20-24 Septembre 2005, CM 2005 Document ASC Edition.

Moore, J.J., Hill, A.S. & Sanderson, W.G. (2005). *Development of CCW Impact Assessment Response Framework for a Marine Oil Pollution Incident.* Prepared for the Countryside Council of Wales by Coastal Assessment Liaison & Monitoring. CCW Marine monitoring Report N°20. 103 pp.