SC/55/E7

State of the cetacean environment report (SOCER)
2003: Second draft

EDITORS: M. STACHOWITSCH, N.A. ROSE, AND E.C.M. PARSONS

*(– negative event; + positive event; * submissions received after circulation of first draft)*

ATLANTIC OCEAN

Chemical pollution

– Oil spills and leakages in Venezuela
Recent oils spills, leakages and other incidents in Lake Maracaibo and the Gulf of Venezuela System have prompted several NGOs to release a statement of concern (available on the website of the NGO Vitalis, see below). This area is the habitat of three species of dolphins; the threat to the tucuxi, whose population status is insufficiently known, is a key concern. At least two tucuxi were found stranded with evidence of human interactions (eviscerated or butchered).
(Submitter: Jaime Bolaños, Venezuela, based on personal observations, symposium abstract and Vitalis website, http://www.vitalis.net/Index2.htm)

– Fuel oil and plastic spill off of Cornwall*
A 1,846 tonne cargo vessel, RMS Mulheim, ran aground on the coast of Cornwall (UK). The vessel's ruptured hull spilt over 100,000 litres of fuel oil and a large quantity of scrap plastic. Although much of the oil will disperse, there were serious concerns about the impact of the spilled plastic on marine wildlife, leading to a major effort by authorities and NGOs to remove over 2000 tonnes of the scrap plastic from the wreck. A spokesperson for the Marine Conservation Society stated that if the plastic were to be released from the wreck it could impact the majority of the UK south coast and potentially the northern French coast too.
(Source: Dive magazine, May 2003)

– TBT still widespread a decade after banning*
Application of butyltin on small boats (<25m) was banned in the UK a decade ago. However, a study on butyltin concentrations in sediments and mussels in the Thames and Mersey estuaries determined that butyltin residues "remain widespread" and "chronic contamination of sediments appears to be an extensive feature in major industrialized estuaries and seems likely to persist for the foreseeable future".
Maximum contaminant levels
TBT ($mg.kg^{-1}$ dry weight) – 0.173 (sediment) and 0.302 (mussels).
(Source: Harino, H., O'Hara, S.C.M., Burt, G.R., Chesman, B.S., Pope, N.D. and Langston, W.J. 2003. Organotin compounds in Mersey and Thames Estuaries a decade after UK TBT legislation. *J. Mar. Biol. Assoc. UK* 83:11-22)

– "Prestige" oil spill
On 19 November 2002 the oil tanker "Prestige" broke in two and sank off the Galician coast of northwestern Spain. The initial loss of ca. 35,000 tons of oil washed up along more than 1000 km of beaches and rocky shores in Spain and France, in an area limited approximately by the 42° and 45° N parallels and 12° W meridian. This upwelling area has a rich marine fauna and important shellfish and fishing activities. Plans are being developed to deal with the wreck, sunk at 2300 m, but still there is the danger of new surges from the fuel remaining in the wreck. The severity of the event is underlined by its great geographic extent and ecological impact. The above factors, along with the presence of several cetacean species here (including striped dolphin, common dolphin, bottlenose dolphin, harbour porpoise, pilot whale, Risso's dolphin, minke whale, fin whale, and sperm whale),

the higher-than-usual strandings of sea turtles and cetaceans, and the temporary closing of fishing activities, indicate the significance of this event for the marine environment.
(Submitter: IWC Scientific Committee member Santiago Lens, Spain, based on report of surveys conducted in 12/02 and 4 web-based sources)

–/+ Pollutant levels in Shannon Estuary (Ireland) bottlenose dolphins
Blubber samples were taken by biopsy in September 2000 from bottlenose dolphins in the Shannon Estuary – Ireland's only Special Area of Conservation for dolphins (designated under the European Habitats Directive). Organochlorine pollutant levels were higher in bottlenose dolphins than recorded in harbour porpoises and common dolphins outside the estuary, but were similar to levels recorded in Ireland-stranded Atlantic white-sided dolphins and bottlenose dolphins from Scotland. Although pollutant levels were elevated, they "were not thought to be a major threat to bottlenose dolphins in the Shannon estuary".
Maximum contaminant levels
Organochlorines ($mg.kg^{-1}$ lipid weight) – DDE: 16.0; trans-nonachlor: 2.30; PCB (congener 138): 7.13 and (congener 153): 10.9.
(Source: Berrow, S.D., McHugh, B., Glynn, D., McGovern, E., Parsons, K.M., Baird, R.W. and Hooker, S.K. 2002. Organochlorine concentrations in resident bottlenose dolphins (*Tursiops truncatus*) in the Shannon estuary, Ireland. *Mar. Poll. Bull.* 44: 1296-1313)

–/+ Radioactive caesium levels in North Atlantic and North Sea minke whales
Tissue samples were taken from minke whales in Norwegian whaling operations in 1998. Most radioactive caesium levels recorded were comparable to levels recorded in contemporary studies. Levels were highest in the North Sea – the elevated North Sea contamination was attributed to outflows from UK and French nuclear fuel reprocessing plants and from the Baltic Sea, the latter containing contamination from the 1986 Chernobyl accident.
Mean contaminant levels (by IWC minke whale stock)
^{137}Caesium ($Bq.kg^{-1}$ lipid weight) – West Greenland: 0.543; East Greenland: 0.589; Jan Mayen: 0.448; Svalbard: 0.298; Barents Sea: 0.569; Vestfjorden/Lofoten: 0.655; North Sea: 1.319.
(Source: Born, E. W., Dahlgaard, H., Riget, F. F., Dietz, R., Øien, N. and Haug, T.. 2002. Regional variation of caesium-137 in minke whales *Balaenoptera acutorostrata* from West Greenland, the Northeast Atlantic and the North Sea. *Polar Biol.* 25: 907-913)

–/+ Proposal for strong new European Directive to control polluting ships*
The European Commission has tabled a proposal for a new Directive that would make it a punishable offence for ships to cause marine pollution. Proposed penalties for polluting include jail sentences for whoever is responsible for the polluting offence (whether owner, captain or charter). The proposed directive would also enact punishment regardless of the flag of convenience being flown by the polluting vessel. However, there is some opposition already for the proposed directive from various transport ministers from EU nations with shipping interests.
(Source: Everett, S. 2003. EC law plan on marine pollution. *British Wildlife* 14:298)

–/+ PCBs and organochlorine pesticides measured in St Lawrence River Estuary beluga whales*
For the first time, organochlorine (OC) contaminants were measured from blubber biopsies from free-ranging beluga whales of the St Lawrence River Estuary and compared to contaminant levels recorded in previously stranded dead belugas. PCBs, DDTs, toxaphene and chlordane-related compounds were the major OC contaminants detected in 44 belugas biopsied between 1994 and 1998. Taken together, results from both biopsied whales and previously studied stranded belugas indicate that PCB and OC pesticide contamination of St Lawrence beluga whales may occur across a broader range of levels than previously thought, at least for males, which formed the largest group in this study, possibly due to different degrees of dietary exposure. It also appears that measuring contaminant concentrations only in stranded whales may overestimate OC levels in the population as a whole, especially for highly chlorinated OCs.
(Source: Hobbs, K.E., Muir, D.C.G., Michaud, R., Beland, P., Letcher, R.J. and Norstrom, R.J. 2003. PCBs and organochlorine pesticides in blubber biopsies from free-ranging St. Lawrence River Estuary beluga whales (*Delphinapterus leucas*), 1994-1998. *Environ. Poll.* 122: 291-302)

+ PCB-153 levels declined in polar bear plasma in northeast Atlantic in 1990s
PCB-153 decreased significantly in plasma collected from polar bears at Svalbard, Norway, during the 1990s. The authors conclude that plasma is the preferred medium from which to measure PCB levels, as levels are less variable than in fat or blood cells. Long-term sampling on a regular basis is essential to determine reliable trends in pollutant levels. This study may indicate a recent trend of decreasing levels of certain organochlorine contaminants in the north Atlantic marine environment.
Mean contaminant level
PCB-153 (ng g^{-1} wet weight) – 33.
(Source: Henriksen, E. O., Wiig, Ø., Skaare, J. U., Gabrielsen, G. W. and Derocher, A. E. 2001. Monitoring PCBs in polar bears: lessons learned from Svalbard. *J. Environ. Monit.* 3: 493-498)

+ "Prestige" oil spill
The sinking of the "Prestige" oil tanker had a major negative impact on the marine environment (see above). The fact that the ship involved was 27 years old and single-hulled, however, prompted transportation ministers from 15 EU nations to agree on a total ban of single-hulled oil tankers over 23 years old. Prohibition of all single-hulled tankers (whatever their age) will be phased in by 2010; for the largest ships, the ban will start in 2005. The ban applies to all ships using EU ports and to vessels flying European flags and is expected to become effective in July 2003. This accelerated phase-out is expected to decrease the risk of major oil spills in European waters.
(Submitter: IWC SC member Michael Stachowitsch, Austria, based on EU Commission document "Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EC) No. 417/2002 on the accelerated phasing in of double hull or equivalent design requirements for single hull oil tankers and repealing Council Regulation (EC) No. 2978/94", along with press and web-based sources)

Habitat protection/degradation

– Dolphin responses to boat traffic*
A positive correlation between boat traffic and breathing synchrony was recorded in bottlenose dolphins from the Moray Firth, NE Scotland. The authors speculate that the impacts of cumulative short-term responses to boat traffic in the Moray Firth may result in a significant impact for the bottlenose dolphins inhabiting the area.
(Source: Hastie, G.D., Wilson, B., Tufft, L.H. and Thompson, P.M. 2003. Bottlenose dolphins increase breathing synchrony in response to boat traffic. *Mar. Mamm. Sci.* 19:74-84)

+ Reducing interactions between vessels and rights whales in Bay of Fundy, Canada*
In April 2002, Transport Canada submitted a proposal to the International Maritime Organization (IMO) to amend the existing Traffic Separation Scheme (TSS) for vessel traffic in the Bay of Fundy, to reduce the potential for interaction between right whales and vessels. The TSS provides for the separation of vessel traffic between the southeastern entrance to the Bay of Fundy and the port of Saint John, New Brunswick. About 800 ships use the TSS annually, primarily tankers, bulk carriers, tugs, container ships, cruise ships and government vessels. The impact of ship strikes on right whales include massive wounds such as fractured skulls, severed tails, and large propeller slashes; collisions have been responsible for a number of deaths. A mean relative probability analysis of right whale sighting data showed that a shift in shipping lanes by about 3.9 nautical miles to the east would reduce the relative probability of a ship-whale interaction by 80%. Implementing the Transport Canada proposal will shift the traffic lanes of the northern segment to the east through areas where the population density of right whales is considerably lower. The proposal was reviewed at the 48th session of the IMO Sub-Committee on Safety of Navigation in July 2002. The proposal was approved by the Sub-Committee and forwarded to the December 2002 meeting of the Maritime Safety Committee (MSC) for adoption. The MSC adopted the proposal on December 5, 2002 and Transport Canada and the Department of Fisheries and Oceans will implement the amended TSS on July 1, 2003.
(Source: Moira Brown, USA and Canada, based on personal observations, the web site www.coastalstudies.org, and *Wild Earth: The Journal of the Wildlands Project*. Endangered right whales: under the shadow of ships. Volume 12 (4):49-53)

Disease and mortality events

– Strandings of beaked whales in the Canary Islands*
On 24 September 2002 12 beaked whales, including Cuvier's beaked whales, Gervais' beaked whales, and Blainville's beaked whales, stranded in the Canary Islands. NATO naval exercises were reportedly being conducted in the area at that time.
(Source: V. Martín, post to MARMAM listserve, 28 September 2002)

– Tattoo skin disease
In a study that included nine species of small cetaceans from the SE Pacific, SW and NE Atlantic, Baltic Sea, North Sea and the Mediterranean between 1988 and 2002, the prevalence of the skin condition known as tattoo disease – skin lesions caused by poxviruses – was high in seven populations. Prevalence of tattoo disease was highest in long-beaked common dolphins (61.1%) and Burmeister's porpoises (60%) from the SE Pacific (Peru), followed by bottlenose dolphins from the NE Atlantic (Sado Estuary, Portugal) and the SE Pacific (values were 48.6% and 41.7%, respectively) and dusky dolphins from the SE Pacific (34.7%). In the Mediterranean the values were 20% (striped dolphin) and 25% (bottlenose dolphin). Harbour porpoises in the Baltic and North Seas, as well as four species in the SW Atlantic, were not affected. Since the authors found a higher incidence of disease in inshore versus offshore taxa (adult specimens), they suggest that this disease may be an indicator of a degrading or stressful aquatic environment, specifically of immunotoxic environmental pollutants of continental origin.
(Source: Van Bressem, M-F., Van Waerebeek, K., Raga, J.A., Gaspar, R., Di Beneditto, A.P., Ramos, R. and U. Siebert. 2003. Tattoo disease of odontocetes as a potential indicator of a degrading or stressful environment: a preliminary report. Document SC/55/E1, International Whaling Commission, Berlin, Germany)

+ Recovery Plan for Baltic Harbour Porpoises
The harbour porpoise is the only cetacean species native to the Baltic Sea. Its low estimated population size (600 individuals) and continued losses due to fisheries bycatch have prompted ASCOBANS to develop a Recovery Plan for Baltic Harbour Porpoises (Jastarnia Plan). By implementing precautionary management measures to reduce the bycatch, developing recovery targets and generally improving knowledge, it hopes to avert a further decline of this population. A potential future oil spill here involving antiquated single-hulled Russian oil tankers operating in winter and heavy ice has been identified as a potential threat.
(Submitter: Viivi Koomson, Finland, based on ASCOBANS website)

MEDITERRANEAN and BLACK SEA

General

– Known and potential threats to cetaceans in the Mediterranean and Black Seas
In February 2002 a review presented to ACCOBAMS determined that cetacean mortality inflicted by human activities included:
(i) Intentional and directed takes, (ii) fishing gear/activities, (iii) ship strikes and (iv) general habitat degradation, which included:
(i) Prey depletion, (ii) contamination by chemical pollutants, (iii) oil pollution, (iv) marine debris, (v) noise pollution, (vi) disturbance, (vii) ecosystem and climate change and (viii) epizootics.
The factors considered to be major and secondary threats to various species are summarized below:
Mediterranean and Black Sea

Fin whale:	vessel collisions (primary); disturbance (secondary).
Sperm whale:	fishing gear/activities, vessel collisions (primary); disturbance (secondary).
Cuvier's beaked whale:	noise pollution (primary); disturbance, marine debris (secondary).
Long-finned pilot whale:	fishing gear/activities (primary); disturbance (secondary).
Risso's dolphin:	disturbance (secondary).

Striped dolphin: fishing gear/activities, chemical pollution (primary); directed takes, prey depletion, disturbance (secondary).

Mediterranean Sea

Bottlenose dolphin: directed takes, prey depletion, chemical pollution (primary); fishing gear/activities, disturbance (secondary).

Common dolphin: prey depletion, chemical pollution (primary); fishing gear/activities, disturbance (secondary).

Black Sea

Bottlenose dolphin: ecosystem and climate change (primary); directed takes, fishing gear/activities, marine debris, disturbance (secondary).

Common dolphin: fishing gear/activities, prey depletion, chemical pollution, ecosystem and climate change (secondary).

Harbour porpoise: fishing gear/activities, chemical pollution, disturbance, ecosystem and climate change (primary); Prey depletion (secondary).

(Source: Notarbartolo di Sciara, G., Aguilar, A., Bearzi, G., Birkun, A., jr and Frantzis, A. 2002. Overview of known or presumed impacts on different species of cetaceans in the Mediterranean and Black Seas. In *Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies* (ed. G. Notarbartolo di Sciara), Section 17, Report to the ACCOBAMS Secretariat, Monaco)

Chemical pollution

– Effects of endocrine disrupters in striped dolphins, common dolphins and fin whales of the Mediterranean Sea*

Levels of endocrine (hormone) disrupting PHAHs in a top predator of the Mediterranean, the striped dolphin, were 1-2 orders of magnitude higher than in Atlantic and Pacific individuals of the same species. Non-lethal skin biopsies were used to look at contaminants and biomarkers in Mediterranean cetaceans. BPMO (Benzo (a)pyrene monoxigenase) activity in biopsy samples was found to be a good indicator of levels of DDTs, *pp*'DDE, *op*'DDT, total PCBs and PCB congener 153 in male specimens of common dolphins. The results also suggest that endocrine disrupting compounds may be a major stress factor for common dolphin populations in the Mediterranean Sea. Similar results were obtained in fin whales sampled in the Ligurian Sea from 1992 to 1995, between BPMO activity and organochlorine levels in skin biopsy specimens for males (but not females or males and females together).

(Source: Fossi, M.C. and Marsili, L. 2002. Effects of endocrine disrupters in aquatic mammals. SCOPE/IUPAC International Symposium on Endocrine Active Substances, November 17-21, 2002, Yokohama, Japan. 13 pp)

– Ecotoxicological status of a SW Mediterranean population of striped dolphins*

A geographical trend of contamination was found for striped dolphins with PCB and DDT levels increasing from the SE (Ionian Sea) to the north (Ligurian Sea). Skin biopsies were used to investigate bioaccumulation of organochlorines and toxic PCDDs (polichlorodibenzo-p-dioxins), PCDFs (polichlorodibenzofurans) and trace elements (Hg, Cd, Pb), as well as investigate levels of BPMO (mixed function oxidase) activity (a biomarker for pollutant contamination) in cetaceans around the Eolian Islands in summer 2002. The BPMO activity value (and therefore level of pollutant contamination) was approximately 3 times higher than the values found in the Ionian and 5 times lower than values recorded in Ligurian Sea cetaceans.

Mean level

BPMO activity (A.U.F.g tissue^{-1}/h) – 43.40.

(Source: Fossi, M.C., Marsili, L., Lauriano, G., Fortuna, C., Canese, S., Neri, G., Ancora, S., Leonzio, C., Romeo, T. and Jiménez, B. 2003. Preliminary assessment of ecotoxicological status of a SW Mediterranean segment population of striped dolphin (*Stenella coeruleoalba*) using skin biopsy. Paper presented at PRIMO (Pollution Responses In Marine Organisms) 12, Florida, U.S.A., May 2003)

– Evaluating toxicological hazards of organochlorine contaminants in Mediterranean cetaceans*

Significant differences in total levels of organochlorine (OC) contamination with endocrine (hormone) disruption potential were found between toothed and baleen whales. Highest mean levels were found in striped dolphins, followed by bottlenose dolphins, then common dolphins. Differences in organochlorine bioaccumulation, metabolic responses and consequently potential risk from endocrine disruption were primarily related to different

positions in the marine food chain. In addition, high levels of a DDT metabolite that is a potent oestrogen-mimic and anti-androgen were detected in fin whales and this could affect the already low reproductive rate of this whale species. Total DDT levels (5169 $ng.g^{-1}$ wet weight) in Mediterranean Sea fin whales were over 12 times higher than found in bowhead whales from Barrow, Alaska that exhibited pseudohermaphroditism, emphasising the potential threat that hormone-disrupting organochlorine pollutants pose to these marine mammals.
Maximum contaminant levels
OC-EDCs ($\mu g.g^{-1}$ fresh weight) – Striped dolphins: 40.0; bottlenose dolphins: 24.3; common dolphins: 15.0.
(Source: Fossi, M.C., Marsili, L., Neri, G., Natoli, A., Politi, E. and Panigada, S. 2003. The use of a non-lethal tool for evaluating toxicological hazard of organochlorine contaminants in Mediterranean cetaceans: new data 10 years after the first paper published in MPB. *Mar. Poll. Bull.*: in press)

– Elevated lead levels in small cetaceans
Tissue samples were analysed from long-finned pilot whales and bottlenose dolphins, striped dolphins, Risso's dolphins and common dolphins stranded on the Corsican coast. Levels of cadmium, copper and zinc were generally comparable to concentrations recorded in animals from UK or Australian waters, although cadmium concentrations in the Mediterranean pilot whales were considerably lower. Lead concentrations in the Mediterranean animals, however, were often an order of magnitude higher than the studies used in comparison.
Maximum contaminant levels
Trace elements ($mg.kg^{-1}$ dry weight) – bottlenose dolphin: Cd: 10; Cu: 46; Pb: 18; Zn: 1107; striped dolphin: Cd: 27; Cu: 28; Pb: 18; Zn: 660; Risso's dolphin: Cd: 63; Cu: 11; Pb: 10; Zn: 874; pilot whale: Cd: 47; Cu: 31; Pb: 21; Zn: 1472; common dolphin: Cd: 5.2; Cu: 30; Pb: 18; Zn: 971.
(Source: Frodello, J.P. and Marchand, B. 2001. Cadmium, copper, lead, and zinc in five toothed whale species of the Mediterranean Sea. *Int. J. Toxicol.* 20: 339-343)

– Elevated mercury levels in Cuvier's beaked whale
Tissue samples were analysed from a single Cuvier's beaked whale stranded on the coast of Corsica. Unremarkable concentrations of lead, cadmium, copper and zinc were recorded, with cadmium levels being lower than those found in the same species in other locations. Total mercury concentrations were very high, higher than previously reported for this species. The authors stated that the high levels of mercury found in the whale may have "play[ed] a part in the death" of the animal.
Maximum contaminant levels
Trace elements ($mg.kg^{-1}$ dry weight) – Cd: 46; Cu: 34; Hg: 27; Pb: 4.2; Zn: 688; Hg: 4730.
(Source: Frodello, J. P., Viale, D. and Marchand, B. 2002. Metal levels in a Cuvier's beaked whale (*Ziphius cavirostris*) found stranded on a Mediterranean Coast, Corsica. *Bull. Environ. Contam. Toxicol.* 69: 662-666)

– Fluorinated hydrocarbons in cetaceans from the Mediterranean Sea*
Toxic pollutant PFOS (Perfluorooctanesulfonate; $C_8F_{17}SO_3^-$) and related fluorinated hydrocarbons were detected in bottlenose dolphins, striped dolphins, common dolphins, fin whales, and long-finned pilot whales from the Italian coast of the Mediterranean Sea. Concentrations of PFOS in blood were higher in bottlenose dolphins than fish such as tuna or swordfish. A significant positive correlation existed between the PFOS concentrations in liver and blood, which indicates that blood can be used for non-lethal monitoring of PFOS concentrations in other organs. FOSA (Perfluorooctanesulfonamide; $C_8F_{17}SO_2NH_2$) was also found in 14 of 19 livers or blood samples of marine mammals from the Mediterranean Sea. The highest concentration of FOSA was found in the liver of a common dolphin. PFOS was a widespread contaminant in marine wildlife from the Baltic and the Mediterranean Seas, while FOSA and PFOA (perfluorooctanoate; $C_7F_{15}CO_2^-$) had a sporadic spatial distribution, whilst the fluorinated hydrocarbon PFHxS (perfluorohexanesulfonate; $C_6F_{13}SO_3^-$) was not found in most of the samples analysed.
Maximum contaminant levels
Fluorinated hydrocarbons ($ng.g^{-1}$ wet weight) – PFOS: 940; FOSA: 878; PFOA: <72; PFHxS: 6.8.
(Source: Kannan, K., Corsolini, S., Falandysz, J., Oehme, G., Focardi, S. and Giesy, J.P. 2002. Perfluorooctanesulfonate and related fluorinated hydrocarbons in marine mammals, fishes, and birds from coasts of the Baltic and the Mediterranean Seas. *Environ. Sci. Tech.* 36:3210-3216)

– Elevated heavy metal concentrations and ingested plastic bags in a Risso's dolphin stranded on the coast of Israel (eastern Mediterranean)*

High concentrations of the trace elements Hg, Cd, Zn, Fe and Sc were reported the tissues of an initially live-stranded Risso's dolphin. Although the cause of death was attributed to bacterial bronchopneumonia in combination with endotoxemia, plastic bags found in its stomach contributed to the dolphin's poor physical condition. However, no connection was found between the high concentrations of trace metals in the internal organs and the cause of death.

Editor's note: This study presents data from an area where there has been relatively little information collected on cetacean contaminant loads.

(Source: Shoham-Fridler, E., Amiel, S., Roditi-Elasar, M. and Kress, N. 2002. Risso's dolphin (*Grampus griseus*) stranding on the coast of Israel (eastern Mediterranean): autopsy and trace metal concentrations. *Sci. Total Environ.* 295:157-166)

– /+ Polycyclic aromatic hydrocarbons (PAHs) in Mediterranean striped dolphins and fin whales*

Potentially toxic and carcinogenic polycyclic aromatic hydrocarbon (PAH) levels were examined in free-ranging Mediterranean cetaceans. In 1991, in the Mediterranean Sea, in the area of the newly established International Sanctuary for Cetaceans, two oil spills occurred, discharging between 46,000 and 66,000 tonnes of crude oil in 12 hours. PAHs are derived from fossil fuel products; therefore, PAH values in cetaceans were measured after these spills. Blubber samples were collected by biopsy from live specimens of fin whales in the Ligurian Sea and striped dolphins in the Ligurian and the Ionian Seas. PAH concentrations in striped dolphins were higher than in fin whales, probably due to the different positions they take in the Mediterranean food web. PAH concentrations seemed to be strongly related to the presence of high levels of PAHs still present in the environment, less than 18 months after the oil spills in the Ligurian and Tyrrhenian Seas.

Maximum contaminant levels

Total PAHs ($ng.g^{-1}$ fresh weight) – fin whales: 1970 [carcinogenic PAHs 89.90]; striped dolphins: 29,500 [carcinogenic PAHs 676.00].

(Source: Marsili, L., Caruso, A., Fossi, M.C., Zanardelli, M., Politi, E. and Focardi, S. 2001. Polycyclic Aromatic Hydrocarbon (PAHs) values in the subcutaneous biopsies of Mediterranean cetaceans. C*hemosphere* 44: 147-154)

–/+ Levels and toxicity of PCBs in the blubber of the South Adriatic bottlenose dolphin*

PCB congener concentrations were determined in the blubber of nine bottlenose dolphins stranded along the southeastern Italian coast. On the basis of the levels of total PCBs, there was considered to be no health risk to the individuals. However, the concentrations of some toxic (non-ortho coplanar) PCBs in the samples analysed were higher than those associated with the morbillivirus epizootic in the Mediterranean Sea. The potential toxicity (TCDD equivalent or TEQ) of the PCB congeners was also calculated. Overall, these results suggest that although the levels of total PCB are quite low, the potential risk of pollution for cetaceans remains high, because of the consistent high toxicity (TEQ) value. However, this study only looked at a sub-set of the possible toxic pollutants, and did not look at the toxic effects combinations of chemicals might have.

Total contaminant levels

PCB ($\mu g.g^{-1}$ wet weight) – 3.53 to 24.4; TEQ ($pg.g^{-1}$) – 45596.

(Source: Storelli, M.M. and Marcotrigiano, G.O. 2003. Levels and congener pattern of polychlorinated biphenyls in the blubber of the Mediterranean bottlenose dolphins *Tursiops truncatus*. *Environ. Internat.* 28:559-565)

Habitat protection/degradation

– Increasing levels of human activities in the Mediterranean

In February 2002 a report presented to ACCOBAMS stated that the "concentration of human populations and activities around the Mediterranean present considerable threats to the marine and coastal environment…the situation, however, is likely to get worse."

- It is estimated that the current population of Mediterranean states (450 million) will rise to 520-570 million by 2030, and 600 million by 2050.
- Although the Mediterranean comprises only 0.8% of the world's surface, it carries 15% of the world's shipping and 30% of all ship-transported oil.
- Between 1980 and 1992, the number of fishing vessels increased by 20%.
- Between 1984 and 1996, aquaculture production increased from 78,000 tonnes to 248,500 tonnes.
- 60% of urban waste dumped in the Mediterranean is still untreated.

- "The rate of introduction of foreign, often noxious substances cannot be overcome by its water turnover rate."

The report also stated, "The Black Sea is widely recognized as one of the regional seas most damaged by human activities". The United Nations Black Sea Environment Programme noted "particularly acute problems have arisen as a result of pollution (notably from nutrients, faecal material, solid waste and oil), a catastrophic decline in commercial fish stocks, a severe decrease in tourism and an uncoordinated approach towards coastal zone management. Increased loads of nutrients from rivers caused an over production of phytoplankton leading to extensive eutrophication and often extremely low dissolved oxygen concentrations. The entire ecosystem [is beginning] to collapse". The report stated that cetaceans were exposed to a variety of threats deriving from human activities including: (i) direct exploitation, (ii) bycatch, (iii) competition and culls, (iv) habitat loss and degradation, (v) contaminants and (vi) disturbance from boat traffic. In addition new or previously unrecognised factors were highlighted including: (i) the effects of global climate change, (ii) reduced prey availability, (iii) contamination of the food web by algal toxins, (iv) vessel collisions, (v) noise pollution and (vi) disturbance by unregulated whale watching. It was pointed out that "threats to cetacean survival can be particularly severe in the Mediterranean and Black Seas, due to the enclosed and semi-enclosed natures of such basins, and to the human density and intensity of activities".
(Source: Notarbartolo di Sciara, G. 2002. Conservation problems: overview. In *Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies* (ed. G. Notarbartolo di Sciara), Section 4, Report to the ACCOBAMS Secretariat, Monaco, February 2002)

+ Re-emergence of harbour porpoise stock thought locally extirpated
Although historically recorded in the 19th century, no harbour porpoises were thought to remain in the northeastern Aegean Sea/Mediterranean basin. However, several strandings discovered since 1997, including a March 2003 stranding, and several undocumented sightings in recent years seem to indicate a remnant stock remains in the NE Aegean.
(Source: Aimilia Drougas, Greece, post to MARMAM listserve, 28 March 2003)

+ Black Sea bottlenose dolphin population given zero quota at CITES
A proposal was submitted at the 2002 CITES meeting to list the declining population of the Black Sea bottlenose dolphin – a population depleted by direct takes, habitat loss, and a decline in habitat quality – on Appendix I of CITES. This would have banned all commercial trade in animals taken from this population. Although the proposal was defeated, the population was retained on Appendix II with a zero quota on the export of live dolphins wild-captured in the Black Sea (for primarily commercial purposes).
(Source: ACCOBAMS web page)

+ Establishment of marine reserves in Spain
Two new marine reserves have been established in Spain. The first is located in the Atlantic Ocean: the Marine Reserve of La Palma (Tenerife), Canary Islands. The second is located in the Mediterranean: the Marine Reserve of Cabo de Gata-Nijar (Almeria). These two relatively small (< 100 km²) reserves will be provided with surveillance and maintenance services and be protected from fisheries, an action that is recognized worldwide to boost invertebrate and fish populations both within and outside reserve boundaries. This is expected to have a positive effect on marine organisms higher up in the food chain, including cetaceans.
(Submitter: IWC SC member Santiago Lens, Spain, based on a report of the Spanish Ministry of Agriculture, Fisheries and Food)

GLOBAL

Chemical pollution

– Heavy metals can be transferred to bottlenose dolphin calves via milk*
This study demonstrated that the metals mercury, lead, copper and zinc can pass from the tissues of a bottlenose dolphin mother to her calf via her milk.
Editor's note: This finding could potentially have important consequences effecting calf mortality and cetacean recruitment rates in cetacean species in contaminated environments.

(Source: Frodello, J.P., Viale, D. and Marchand, B. 2002. Metal concentrations in the milk and tissues of a nursing *Tursiops truncatus* female. *Mar. Poll. Bull.* 44: 551-576)

– Mercury pollution worldwide*

A report was released by UNEP on mercury and its chemistry, toxicology, human exposure, impacts on the environment, sources and cycling, production and uses, prevention of release and control measures, as well as an identification of information gaps and future issues regarding all types of mercury globally. Although the report does not focus on cetaceans, it documents the effects of mercury on other species and impacts to all ecosystems. It also points out the potential of newly flooded areas to aid in the mobilisation of mercury though increased methylation and stresses that, as a result, aquatic food chains tend to have higher Hg levels. Accordingly, whales are shown to have the largest range of Hg levels in muscle, liver and kidney tissue. The report notes that mercury levels in beluga whales in the Arctic have quadrupled in a 25-year period.

(Source: UNEP. 2002. *Global Mercury Assessment.* UNEP Chemicals, Geneva, Switzerland)

– Pollutant levels in free-ranging Alaskan killer whales

Blubber samples were taken by biopsy in September 2000 from killer whales in the Kenai Fjords and Prince William Sound, Alaska. Organochlorine pollutant levels were extremely high, amongst some of the highest recorded in cetaceans globally. DDT levels were 25 times higher in transient killer whales than those recorded in resident killer whales from the same region and PCB levels were 15 times greater. The toxicity levels were comparable to toxicity levels in resident killer whales and harbour seals in Puget Sound, but lower than levels reported for striped dolphins involved in the Mediterranean morbillivirus epizootic, two species of dolphin from the Italian coast of the Mediterranean, and harbour porpoises from the Baltic Sea. The high pollutant loads were attributed to the transient killer whale's diet: principally Dall's porpoise and harbour seals, which contain higher levels of pollutants than the prey of resident killer whales. More than 90% of the killer whales contained PCB concentration greater than levels attributed to reproductive dysfunction in ringed seals, harbour seals and sea otters and immune dysfunction in Rhesus monkeys.

Maximum contaminant levels

Organochlorines ($mg.kg^{-1}$ lipid weight) – $\sum$ PCB: 500; $\sum$DDT: 860 and $\sum$TEQs ($ng.kg^{-1}$) – 860.

(Source: Ylitalo, G. M., Matkin, C. O., Buzitis, J., Krahn, M. M., Jones, L. L., Rowles, T. and Stein, J. E. 2001. Influence of life-history parameters on organochlorine concentrations in free-ranging killer whales (*Orcinus orca*) from Prince William Sound, AK. *Sci. Total Environ.* 281:183-203)

+ Arsenic levels in marine mammals measured for first time

Arsenic concentrations were determined in livers of 226 individuals representing 16 different marine mammal species, to elucidate its accumulation with age, sex and feeding habits. Samples were taken from the Black Sea, Atlantic Canada, Lake Baikal and the Caspian Sea, as well as from the Pacific. The authors believe that this is the first comprehensive comparative examination of arsenic levels in marine mammals. Future studies should compare their values to those found in this study in order to observe potential trends in contaminant levels.

Mean contaminant level (for all cetacean species examined)

Ar ($\mu g\ g^{-1}$ dry weight) – 2.77 ± 1.17

(Source: Kubota, R., Kunito, T. and Tanabe, T. 2001. Arsenic accumulation in the liver tissue of marine mammals. *Environ. Poll.* 115: 303-312)

+ New technique development: a biomarker to assess dioxin and PHAH susceptibility

In order to assess susceptibilities to concentrations of the highly toxic dioxin TCDD (2,3,7,8-Tetrachlorodibenzo-*p*-dioxin) and related PHAHs (planar halogenated aromatic hydrocarbons), the characteristics of AHR (Aryl Hydrocarbon Receptor) – a regulatory protein that binds to and mediates the effects of TCDD – were investigated in the harbour seal. The study discovered that seal AHR (which was closely related to beluga whale and human AHR) bound to PHAHs, suggesting that harbour seals may be susceptible to PHAH effects. The study suggested that AHR characteristics can be used as a biomarker to investigate susceptibility to dioxin-like compounds and make an "assessment of the risk of these compounds to marine mammals and other protected animals".

(Source: Kim, E. and Hahn, M. E. 2002. cDNA cloning and characterization of an aryl hydrocarbon receptor from the harbor seal (*Phoca vitulina*): a biomarker of dioxin susceptibility. *Aquatic Toxicol.* 58: 57-73)

Climate change

– 2002 was the second hottest year on record

In December 2002 the World Meteorological Organization determined that 2002 was the second warmest year on record (with 2001 being the third warmest year). The year 1998 remains the warmest (for both land and sea surface areas) since records began in 1860. The trend for increasing world temperatures has implications for the distribution and status of cetaceans and their prey species.
(Source: Environment News Service, 18 December 2002 and ACCOBAMS website)

Disease and mortality events

– Elevated levels of trace element linked to mass mortality involving Caspian seals

Tissue samples were taken from healthy Caspian seals in 1998 and compared to animals infected with canine distemper virus that stranded in 2000 on the coast of the Caspian Sea. Concentrations of many toxic elements in the stranded animals were comparable or lower than healthy animals. However, levels of zinc and iron were much higher in diseased animals. In addition, decreasing seal blubber thickness was correlated with increasing zinc levels in kidney tissue. The results "indicate a disturbance in Zn homeostasis in these animals".
Editor's note: These results have global application to marine mammals.
Maximum contaminant levels
Trace elements ($mg.kg^{-1}$ wet weight) – Ag: 0.083; As: 0.33; Cd: 20.3; Co: 0.043; Cr: 0.252; Cu: 11.0; Hg: 27; Org-Hg: 2.8; Mn: 12.5; Mo: 0.737; Pb: 0.084; Se: 13.0; Tl: 0.056; V: 0.24; Fe: 1800; Zn: 166
(Source: Anan, Y., Kunito, T., Ikemoto, T., Kubota, R., Watanabe, I., Tanabe, S., Miyazaki, N. and Petrov, E. A. 2002. Elevated concentrations of trace elements in Caspian Seals (*Phoca caspica*) found stranded during the mass mortality events in 2000. *Arch. Environ. Contam. Toxicol.* 42: 354-362)

Noise Impacts

– Noise from whale-watching boats*

High-speed boats could contribute to permanent hearing loss in killer whales. A model used to predict the effects of noise generated by boats on killer whales predicted that, for boats travelling faster than 10 knots, the distances from the source for sound to be audible, have a masking effect and to induce a behavioural response were 16km, 14km, and 200 metres respectively. The exposure time required to cause a 5dB temporary threshold shift in hearing was an estimated 30-35 minutes, for animals within 450 metres of the vessel. These effects would be reduced for boats travelling at lower speeds. It was postulated by the author that exposure to boat noise for prolonged periods had the potential to induce permanent hearing loss. Thus, high-speed vessels circling animals were considered to be a cause for concern.
(Source: Erbe, C. 2002. Underwater noise of whale watching boats and potential effects on killer whales (*Orcinus orca*) based on an acoustic impact model. *Mar. Mamm. Sci.* 18:394-418)

– Acoustic harassment devices (AHDs) displace killer whales from preferred habitat*

Two independent studies on the natural history of killer whales monitored the occurrence of killer whales from January 1985 through December 2000 in two adjacent areas: Johnstone Strait and the Broughton Archipelago in British Columbia, Canada. Extremely loud acoustic harassment devices (AHDs) were installed and operated through 1993 on salmon farm net pens in the Broughton Archipelago, to deter harbour seals from the nets. When the AHDs were in use, whales were displaced from the Archipelago (declined significantly in number) to the Strait (increased significantly in number). In 1999, AHDs were removed, and whale occurrence returned to pre-1985 baseline levels. This study concluded that the deliberate introduction of loud noise to their environment displaced killer whales. This result has universal application to marine mammals in a number of environments with introduced noise sources.
(Source: Morton, A.B. and Symonds, H. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada. *ICES J. Mar. Sci*. 59:71-80)

– AHDs cause a decline in porpoise abundance*

Harbour porpoise abundance declined precipitously when AHDs ("seal scrammers" or scarers) were activated in British Columbia, Canada. Studying porpoise movements suggested that the few porpoises that ventured into the

study area spent less time within it when the AHD was activated. No porpoises were observed within 200m of the AHD when it was activated. The effect of the AHD diminished with distance. The number of sightings and re-sightings observed when the AHD was activated was less than 0.2% of the number expected had there been no AHD effect at a range of 200-399 m. Even at a range of 2,500-3,500 m from the AHD, only 3.3% of the number of expected sightings was recorded. These data strongly suggest that the impact of AHDs on harbour porpoises extends beyond 3.5 km from the site of an AHD. This study illustrates the "law of unintended consequences" when AHDs are used to deter seals.
(Source: Olesiuk, P.F., Nichol, L.M. and Ford, J.K.B. 2002. Effect of sound generated by an acoustic harassment device (AHD) on the relative abundance and distribution of harbour porpoise (*Phocoena phocoena*) in Retreat Passage, British Columbia. *Mar. Mamm. Sci.* 18: 843-862)

– Underwater noise from wind farms and harbour porpoises*
Sound levels produced from 3 different types of wind turbines were compared with a harbour porpoise audiogram. For the harbour porpoise the noise level at 315Hz from a 450kW Bonus turbine, was 17dB above the expected porpoise hearing threshold. It was estimated that the maximum detection distance for porpoises from the turbines at that frequency was 50 m. It was noted that noise from different wind turbines will be audible at different distances over different frequencies and detection distances would also be dependent on local conditions and ambient noise.
(Source: Henriksen, O.D., Teilmann, J., Dietz, R. and Miller, L. 2001. Does underwater noise from offshore wind farms potentially affect seals and harbour porpoises? Poster presented at the 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada, November 2001)

–/+ Underwater sounds from human activities in a cetacean marine protected area
Sounds were recorded near Sha Chau island, Hong Kong, China, an important habitat for Indo-Pacific humpback dolphins. The results of the study showed that "the Sha Chau area is normally noisy underwater, with the lowest broadband levels measured corresponding to those expected during a storm at sea (sea state 6)". Noise came from the directly adjacent Urmston Road shipping channel and from tankers for an aviation fuel-receiving terminal situated on the coast of Sha Chau. Dolphin conservation measures require that fuelling terminal vessels should not produce noise levels greater than 110 dB (re 1μPa^2/Hz) at frequencies above 330Hz, at distances of greater than 300m. The authors noted "the Sha Chau area…is a highly noisy environment, and we suspect that hearing threshold shifts, physiologic damage to hearing, and masking of biologically meaningful sounds may well be occurring simultaneously". Few studies have been conducted in such detail on anthropogenic noise pollution in coastal waters, and this is one of the first studies looking at this issue in a marine protected area for cetaceans.
Tanker noise levels
141 dB re 1μPa at 100Hz, 100m from the sound source
146 dB re 1μPa at 10-20 kHz broadband, 100m from the sound source
Editor's note: The study area was within the Sha Chau/ Lung Kwu Chau Marine Park, a protected area established to conserve Indo-Pacific humpback dolphins in Hong Kong.
(Source: Würsig, B. and Greene, C.R. jr. 2002. Underwater sounds near a fuel receiving facility in western Hong Kong: relevance to dolphins. *Mar. Environ. Res.* 54: 129-145)

Habitat protection/degradation

– Vessel collisions and the risk to cetaceans
A review of data detailing collisions between vessels and whales was conducted. In order of frequency, from highest to lowest, fin whales, right whales, humpback whales, sperm whales, and gray whales are commonly hit. Ships equal to or greater than 80m in length cause most lethal or severe injuries. Most lethal or severe injuries involve ships travelling 14 knots or faster. Ship strikes can significantly affect small populations of whales, such as the North Atlantic right whale.
(Source: Laist, D.W., Knowlton, A. R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whales. *Mar. Mamm. Sci.* 17: 35-75)

Species glossary

Sperm whale	*Physeter macrocephalus*
Blue whale	*Balaenoptera musculus*
Fin whale	*Balaenoptera physalus*
Minke whale	*Balaenoptera acutorostrata*
Bowhead whale	*Balaena mysticetus*
Gray whale	*Eschrichtius robustus*
Right whale	*Eubalaena borealis*
Cuvier's beaked whale	*Ziphius cavirostris*
Gervais' beaked whale	*Mesoplodon europaeus*
Blainville's beaked whale	*Mesoplodon densirostris*
Beluga (white) whale	*Delphinapterus leucas*
Long-finned pilot whale	*Globicephala meleas*
Kill whale	*Orcinus orca*
Atlantic white-sided dolphin	*Lagenorhynchus acutus*
Dusky dolphin	*Lagenorhynchus obscurus*
Bottlenose dolphin	*Tursiops truncatus*
Common dolphin	*Delphinus delphis*
Risso's dolphin	*Grampus griseus*
Striped dolphin	*Stenella coeruleoalba*
Indo-Pacific humpback dolphin	*Sousa chinensis*
Harbour porpoise	*Phocoena phocoena*
Dall's porpoise	*Phocoenoides dalli*
Burmeister's porpoise	*Phocoena spinipinnis*
Tucuxi	*Sotalia fluviatilis*
Caspian seal	*Phoca caspica*
Harbour seal	*Phoca vitulina*
Ringed seal	*Phoca hispida*
Polar bear	*Ursus maritimus*
Sea otter	*Enhydra lutris*
Common mussel	*Mytilus edulis*

Glossary of terms

ACCOBAMS: Agreement on Conservation and Cetaceans in the Black and Mediterranean Seas.

Ag: Silver

AHDs: Acoustic harassment devices, loud noise sources used to deter (displace) predators such as seals or sea lions from fish concentrations of interest to people, such as in fish farm pens or by dams.

Androgen: a male hormone.

As: Arsenic

ASCOBANS: Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas.

Biopsy: Removal of tissue or cells from the living body for non-lethal examination or study, especially for diagnostic purposes.

Bq: Becquerel, a measure of radioactivity based on number of nuclear disintegrations per second.

Cs: Caesium. The radioactive isotope of the element caesium (Cs 137) is not naturally present in the environment and is therefore often used as an indicator of radioactive pollution (nuclear weapons testing, nuclear reprocessing plants) in the marine ecosystem. It has a half-life of 30 years.

Cd: Cadmium

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Co: Cobalt

Congener: Chemically, any one of up to several hundred different forms of a particular class of chemical, e.g. of PCBs.

Cr: Chromium

Cu: Copper

DDT: The organochlorine pesticide [1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane] that tends to accumulate in the ecosystem and in the blubber and certain internal organs of cetaceans.

Fe: Iron

Hg: Mercury

Hz: Hertz, a measure of sound frequency (pitch), in wave cycles per second.

kW: Kilowatt, a measure of energy output.

MARMAM: Moderated email discussion listserve, established in 1993, which focuses on marine mammal research and conservation, run through the University of Victoria.

Mn: Manganese

Mo: Molybdenum

NGO: Non-governmental organization.

Oestrogen: a female hormone.

Organochlorines: Organic compounds that contain chlorine. Many are toxic and are used as pesticides. Most of these compounds persist in the environment (are not biodegradable) and also tend to accumulate in fatty tissue (e.g. blubber) of cetaceans and other marine organisms.

Pb: Lead

PCBs: Polychlorinated biphenyls (209 different forms or congeners that contain differing numbers of chlorine atoms arranged in various positions on the aromatic rings) are industrial organochlorines that were manufactured to be used in electrical transformers and other applications. These man-made chemicals do not occur naturally and all traces reflect pollution.

Sc: Scandium

Se: Selenium

TEQ: Toxic Equivalent. The overall toxicity or environmental threat posed by a set of closely related pollutants.

Tl: Thallium

V: Vanadium

Zn: Zinc