

STATE OF THE CETACEAN ENVIRONMENT REPORT (SOCER) 2004

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(- negative event, + positive event)

PACIFIC OCEAN

HABITAT PROTECTION/DEGRADATION

+ Fiji declares its Exclusive Economic Zone a whale sanctuary

The Fiji government has declared Fiji's Exclusive Economic Zone (EEZ) a whale sanctuary, contributing to a growing South Pacific network of EEZ whale sanctuaries.

(SOURCE: Marine Pollution Bulletin News. 2003. Whale populations under protection and destruction. *Mar. Poll. Bull.* 46: 530)

+ New zoning plan for Great Barrier Reef

A new Zoning Plan for the Great Barrier Reef Marine Park will provide the largest network of protected marine areas in the world. The Plan will increase the Park area protected from extractive practices from only 4.5% to 33.3%. Over 30 different species of whales and dolphins may occur in the Great Barrier Reef Marine Park, including species that are listed as threatened internationally and under Australian and Queensland legislation. The network of new "Green Zones" might be of interest as a concept in the creation of mosaics of protected areas elsewhere.

(SOURCE: Marine Pollution Bulletin News. 2004. New zoning plan for Great Barrier Reef. *Mar. Poll. Bull.* 48: 206)

+ International treaty to limit the introduction of alien species via ballast water

In February 2004, more than 100 nations were expected to sign a UN treaty, under the International Maritime Organisation, to regulate the management of ballast water. Ballast water is a major vector for the transportation of invasive marine species, which in turn can cause significant disruption of ecosystems.

(SOURCE: McCarthy, M. 2004. How a Chinese crab and other 'stowaways' are threatening the sea's ecosystem. *The Independent*, 10 February.)

+ Multi-level sanctuary proposed to protect dolphins from boat traffic

Due to concerns over the impacts whalewatching on bottlenose dolphins in Doubtful Sound, New Zealand, in particular decreases in resting behaviour as the result of disturbance, a multi-level sanctuary has been proposed. This sanctuary would be based on critical habitat use and behaviour in critical habitat: areas of high bottlenose dolphin abundance and key resting areas would become no-boat zones. Secondary areas would allow boat access, but only for researchers or permitted whalewatching vessels. This paper describes a method of identifying critical habitat areas, based on behaviour when dolphins are most sensitive to disturbance.

(SOURCE: Lusseau, D. and Hingham, J.E.S. 2004. Managing the impacts of dolphin-based tourism through definition of critical habitats: the case of bottlenose dolphins (*Tursiops* spp.) in Doubtful Sound, New Zealand. *Tourism Management* 25: in press)

+ New initiative to reduce marine debris in Australia

A new report "*Finding Solutions: Derelict Fishing Gear and Other Marine Debris in Northern Australia*", prepared by the Key Centre for Tropical Wildlife Management at Charles Darwin University for the National Oceans Office, presents options and recommendations for tackling the marine debris that threatens protected species such as sea turtles and whales. The greatest danger is discarded fishing gear, particularly nets, of which 80% in northern Australia are likely to be from foreign sources.

(SOURCE: Marine Pollution Bulletin News. 2004. Marine debris endangers marine species. *Mar. Poll. Bull.* 48: 206)

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-/+ Marine debris monitoring in southern Australia

The longest running annual survey of ocean-based litter in Australia revealed a large but gradual decline in the amount of beach washed litter from 1991-1999. Most of the litter washed ashore originates from commercial fishing activities within the Great Australian Bight (*i.e.*, bait buckets, baskets, pots, trawl nets, monofilament gillnets and longlines). Although there is currently no national program or management framework to assess, manage and monitor ocean-based litter along Australia's coasts, the results indicate increasing compliance to MARPOL (Annex V) by commercial fisheries and shipping here. However, a sharp increase in litter in 2000, probably due to stronger than average onshore surface flow, and the slower than average decrease in fisheries-related debris indicate a continued entanglement threat to marine life.

(SOURCE: Edyvane, K.S., Dalgetty, A., Hone, P.W., Higham, J.S. and Wace, N.M. 2004. Long-term marine litter monitoring in the remote Great Australia Bight, South Australia. *Mar. Poll. Bull.* In press)

- Increasing risk of whale entanglement in Australia

There have been at least five instances, including at least one fatality, of southern right whale entanglement (in fishing or shark net associated lines, nets and buoys) recorded in Australian waters. On the eastern coast of Australia, five instances of humpback whale entanglement were recorded between 1998 and 2003, resulting in three fatalities. Some environmental impact assessments for proposed aquaculture installations, which could potentially cause cetacean entanglement, either ignore or seriously understate risks to.

(SOURCE: Allen, S. and Bejder, L. 2003. Southern right whale *Eubalaena australis* sightings on the Australian coast and the increasing potential for entanglement. *Pacific Conserv. Biol.* 9:228-233)

- Ongoing entanglement of Australian and New Zealand pinnipeds

Entanglement rates of Australian sea lions and New Zealand fur seals have not decreased in recent years in South Australia. Current entanglement rates are the third and fourth highest reported for any seal species. The sea lions were most frequently entangled in monofilament gillnet (shark fishery), the fur seals in loops of packing tape and trawl net fragments (rock lobster and trawl fisheries). These sources of entanglement have the potential to impact cetaceans.

(SOURCE: Page, B., McKenzie, J., McIntosh, R., Baylis, A., Morrissey, A., Calvert, N., Haase, T., Berris, M., Dowie, D., Shaughnessy, P.D. and Goldsworthy, S.D. 2004. Entanglement of Australian sea lions and New Zealand fur seals in lost fishing gear and other marine debris before and after Government and industry attempts to reduce pollution. *Mar. Poll. Bull.* In press)

- Marine debris on Hawaiian beaches

This study shows that small-plastic debris is ubiquitous on even the most remote Pacific islands. By weight, 72% of the debris recovered from the beaches was plastic, with 11% of the total 19,100 pieces comprising pre-production plastic pellets used in plastic injection factories to form consumer products. Plastic particles can be ingested by planktivores, and the study underlines the need for examining the fate of this material in the sea, including its potential accumulation up the food chain and the transfer of chemical pollutants they contain to organisms.

(SOURCE: McDermid, K.J. and McMullen, T.L. 2004. Quantitative analysis of small-plastic debris on beaches in the Hawaiian archipelago. *Mar. Poll. Bull.* 48: 790-794)

- Immense field of marine debris reported

The Algalita Marine Research Foundation (US), using the oceanographic research vessel *Algalita* to conduct a 6000-mile transect across the North Pacific Central Gyre in 2002, reported an immense field of plastic debris almost the size of Central Europe between Hawaii and California. Using various types of trawling equipment and sampling at the surface, 10m and 30 m depth, they reconfirmed a 6:1 weight ratio of floating and suspended plastic to zooplankton calculated during their 1999 Gyre Survey. The persistence of this plastic debris, the range of objects found and its extensive distribution pose a threat to a wide variety of marine organisms, including cetaceans.

(SOURCE: GEO 3:180-181. 2004; www.algalita.org)

- Aquaculture facilities causing habitat loss for dusky dolphins in New Zealand

In New Zealand waters, over five years, only eight of 621 dusky dolphin groups entered the boundaries of shellfish aquaculture sites, and were significantly less likely to be present in these areas. However, occurrence was high in several proposed aquaculture areas, with as many as 55% of individuals occupying areas of greatest proposed development in winter months. The authors consider that proposed aquaculture facilities could severely reduce winter foraging areas for dusky dolphins. In addition to the conservation implications of this habitat loss, the authors point out that there could be socio-economic implications, as in summer months dusky dolphins are the focus of an economically important dolphin-watching industry.

(SOURCE: Markowitz, T.M., Harlin, A.D., Würsig, B. and McFadden, C.J. 2004. Dusky dolphin foraging habitat: overlap with aquaculture in New Zealand. *Aquatic Conservation: Marine and Freshwater Ecosystems* 14:133-149)

- Parasites on salmon could impact killer whale prey species

High levels of parasite infestation have been recorded in juvenile wild pink salmon in areas with salmon aquaculture sites in British Columbia, Canada; these levels would be lethal in Atlantic salmonids. Every year that high sea lice loads have been detected in wild pink salmon, the stock has declined precipitously (98% and 87%). Salmon are a major prey species for killer whales in this area and a collapse in wild salmon stocks could have major repercussions for this species.

(SOURCE: Morton, A., Routledge, R., Peet, C. and Ladwig, A. 2004. Sea lice (*Lepeophtheirus salmonis*) infection rates on juvenile pink (*Oncorhynchus gorbuscha*) and chum salmon (*Oncorhynchus keta*) in the nearshore marine environment of British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 61: 147-157 AND: Morton, A. and Williams, R. 2004. First report of the sea louse, *Lepeophtheirus salmonis*, on juvenile pink salmon, *Oncorhynchus gorbuscha*, in nearshore habitat. *Canadian Field-Naturalist* 117: in press)

- Swim-with-dolphin tour operators fail to comply with regulations

Researchers investigated compliance of whalewatching operators with regulations governing swim-with-dolphin tours (involving bottlenose dolphins) in Port Phillip Bay, Australia. A permitted tour operator is required to comply with these regulations, but all of the regulations were broken by operators during the study period. Compliance with regulations was poorest for the two regulations involving time limits (only 61-62% non-compliance), as opposed to the regulations regarding approaches and avoiding calves (36% and 31% non-compliance, respectively). This study illustrates a high level of non-compliance with regulations controlling dolphin tourism activities.

(SOURCE: Scarpaci, C., Dayanthi, N. and Corkeron, P. 2003. Compliance with regulations by "swim-with-dolphins" operations in Port Phillip Bay, Victoria, Australia. *Environmental Management* 31: 342-347)

- Human activities cause changes in bottlenose dolphin behaviour and habitat use in Moreton Bay, Australia

Human activities (trawling) result in segregation and different patterns of habitat use in two communities of bottlenose dolphins in Moreton Bay, Australia; the behaviour of one community is influenced by environmental factors such as tide and season, whereas human activities are the main influence on the behaviour of the other community. The authors conclude that in Moreton Bay human activities are influencing the social structure, behaviour, and distribution of inshore delphinids and that in the long term there may be impacts on community size, demography and genetic structure.

(SOURCE: Chilvers, B.L., Corkeron, P.J. and Puotinen, M.L. 2003. Influence of trawling on the behaviour and spatial distribution of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in Moreton Bay, Australia. *Can. J. Zool.* 81:1947-1955)

- Boat traffic causes decrease in bottlenose dolphin resting

A survey conducted in the Bay islands Area, New Zealand determined that boat traffic affected bottlenose dolphin behaviour; in particular, increased boat traffic caused a decrease in observed resting behaviour. Increasing amounts of boat traffic and increased whale-watching effort are therefore reducing the amount of rest time available to the dolphins. The researchers considered that the impacts of dolphin-watching in the Bay of Islands region were substantial and that current legislation and regulation in New Zealand were insufficient for protecting this dolphin population from whalewatching-related disturbance.

(SOURCE: Constantine, R., Brunton, D.H. and Dennis, T. 2004. Dolphin-watching tour boats change bottlenose dolphin (*Tursiops truncatus*) behaviour. *Biol. Conserv.* 117:299-307)

CHEMICAL POLLUTION

+ Low levels of organochlorines in spotted dolphins from the Pacific coast of Panama

Biopsy samples of 63 spotted dolphins from the Pacific coast of Panama were examined for organochlorine levels: HCB, PCB and DDT levels were relatively low. Ratios of DDT to its metabolites suggest a local reduction in DDT input and a high rate of DDT degradation.

Mean contaminant levels

Organochlorines (mg.kg⁻¹ lipid weight) HCB: 0.064; PCB: 2.30; DDT: 6.4

(SOURCE: Borrell, A., Cantos, G., Pastor, T. and Aguilar, A. 2004. Levels of organochlorine compounds in spotted dolphins from the Coiba archipelago, Panama. *Chemosphere* 54:669-677)

-/+ Organochlorine concentrations in sperm whales

The concentrations of DDTs and PCBs in mass-stranded sperm whales in Tasmania were higher than previously reported for this species in the Southern Hemisphere, yet lower than corresponding values in the Northern Hemisphere. The HCH values were mostly below detection levels or very low. Although

mass-stranded animals are thought to represent the best source of unbiased samples, the high variability in the relationships among organochlorines, sex, age, and reproductive groups points to the need for coordinated, standardized monitoring procedures. Nonetheless, differences between stranding groups point to the potential of using these pollutants to discriminate social/foraging groups and highlight diet as a primary influence on organochlorine concentrations.

Total contaminant levels

Organochlorines ($\mu\text{g}\cdot\text{g}^{-1}$ lipid weight) ΣDDT : 0.2-9.4; ΣPCB : 0.3-3.3

(SOURCE: Evans, K., Hindell, M. and Hince, G. 2004. Concentrations of organochlorines in sperm whales (*Physeter macrocephalus*) from Southern Australian waters. *Mar. Poll. Bull.* 48: 486-503)

-/+ Metals and organochlorines in small cetaceans

A total of six stranded individuals of three species (bottlenose dolphin, common dolphin and melon-headed whale) were examined on the east coast of Australia. The concentration ranges of most metals were within those reported previously for small cetaceans from the UK and other areas, with Pb being low or undetectable. The concentrations of most organochlorines were also low in all samples, with blubber CB concentrations being low relative to those in many small cetaceans from the UK. The highest concentrations of *p,p'*-DDE, for example, were observed in the melon samples from an inshore adult bottlenose dolphin. The melon is a unique physiological organ and, as a major lipid reservoir that (as opposed to blubber) is not remobilized, it may represent a "memory" of the uptake of lipophilic contaminants over time.

(SOURCE: Law, R.J., Morris, R.J., Allchin, C.R., Jones, B.R. and Nicholson, M.D. 2003. Metals and organochlorines in small cetaceans stranded on the east coast of Australia. *Mar. Poll. Bull.* 46: 1206-1211)

-/+ First detailed subcellular analysis of toxic elements in porpoise livers

The liver is the central organ for the detoxification of toxic chemicals and internal metabolic wastes, as well as for storage of essential elements. This paper is the first to examine the levels of essential elements and the toxic elements Hg, Cd, and Ag in the livers (total and subcellular distribution) of a mother-foetus pair. In Dall's porpoise off Japan, the levels of these toxic elements were much lower in the foetus, indicating potential mechanisms that limit the maternal to foetal transfer in this species, especially for Cd (82 times lower in the foetus). Such studies at the subcellular level underline the complexity of trace element studies and can provide insights into the metabolic mechanisms in maternal and foetal cetaceans.

(SOURCE: Yang, J., Kunito, T., Anan, Y., Tanabe, S. and Miyazaki, N. 2004. Total and subcellular distribution of trace elements in the liver of a mother-fetus pair of Dall's porpoises (*Phocoenoides dalli*). *Mar. Poll. Bull.* In press)

-/+ Radionuclides in small cetaceans of Japan and the Philippines

Radioactive elements $^{137}\text{Caesium}$ and $^{40}\text{Potassium}$ were recorded in Fraser's dolphins from the Philippines and Dall's porpoises from Otsuchi, Japan. Maximum radioactive caesium levels were lower than in areas such as the Caspian and Black Seas and the Northern Atlantic. However, maximum radioactive potassium levels were similar to these more contaminated areas.

Maximum contaminant levels

^{137}Cs ($\text{Bq}\cdot\text{kg}^{-1}$ wet weight) Fraser's dolphin, Philippines: 0.41; Dall's porpoise, Japan: 0.22

^{40}K ($\text{Bq}\cdot\text{kg}^{-1}$ wet weight) Fraser's dolphin, Philippines: 127; Dall's porpoise, Japan: 122

(SOURCE: Yoshitome, R., Kunito, T., Ikemoto, T., Tanabe, S., Zenke, H., Yamauchi, M. and Miyazaki, N. 2003. Global distribution of radionuclides (^{137}Cs and ^{40}K) in marine mammals. *Environ. Sci. Technol.* 37: 4597-4602)

- High levels of lead recorded in Mexican gray whales

In 1999, there was a correlation found between the levels of trace elements found in the sediments of Ojo de Liebre Lagoon, Mexico and the tissues of calf and juvenile gray whales that stranded there. Most trace element levels were similar to levels recorded elsewhere. Lead levels, however, were relatively high in kidney and bone tissue. These levels may potentially have toxicological impacts.

Maximum contaminant levels

Trace elements ($\text{mg}\cdot\text{kg}^{-1}$ dry weight) As: 0.35 (bone); Fe: 447 (kidney); Mn: 16.1 (bone), 8.5 (kidney); Pb: 18.6 (bone), 31.6 (kidney); Se: 2.7 (skin); Zn: 57 (kidney).

(SOURCE: De Luna, C.J. and Rosales-Hoz, L. 2004. Heavy metals in tissues of gray whales *Eschrichtius robustus*, and in sediments of Ojo de Liebre lagoon in Mexico. *Bull. Environ. Contam. Toxicol.* 72: 460-466)

- High levels of mercury in South Pacific short-finned pilot whales

Two short-finned pilot whales and two pygmy sperm whales stranded in New Caledonia in the South Pacific and were analysed for trace element concentrations. Of the two species, the pilot whales had the highest cadmium, selenium, zinc and mercury concentrations. Levels of mercury were particularly high in short-finned pilot whales. The authors suggest that pilot whales may have a physiology that promotes the accumulation of toxic trace elements.

Maximum contaminant levels

Trace elements (mg.kg⁻¹ liver dry weight) Al: 17.0; Cd: 464.4; Cr: 2.51; Cu: 51.0; Fe: 3120; total-Hg: 1452; organic-Hg: 11.7; Mn: 7.1; Se: 758; V: 0.68; Zn: 135.7; Co and Ni: < detection limits
(SOURCE: Bustamante, P., Garrigue, C., Breau, L., Caurant, F., Dabin, W., Greaves, J. and Dodemont, R. 2003. Trace elements in two odontocete species (*Kogia breviceps* and *Globicephala macrorhynchus*) stranded in New Caledonia (South Pacific). *Environ. Poll.* 124:263-271)

- Record levels of mercury found in South Australian bottlenose dolphins

In an analysis of 114 bottlenose dolphins, mercury levels in one animal were four times higher than Australia's previous worst mercury contamination case. It was noted that mercury contamination levels in inshore bottlenose dolphins were on average 14 times higher than offshore common dolphins

Maximum contaminant level

Mercury (mg.kg⁻¹): 1900

(SOURCE: DeGirolamo, R. 2004. Mercury fears with dead dolphins. *The Australian*, 27 January)

- Toxic effects noted when rats fed on market-purchased whale meat

A single dose of boiled whale liver, which had been sold for human consumption in a Japanese market, was fed to laboratory rats and resulted in increased kidney mercury concentrations and higher volumes of excreted urine. Urine analysis suggested renal toxicity due to inorganic mercury. The authors concluded that human consumption of boiled whale liver may cause acute intoxication by contaminated inorganic mercury. Such acute intoxication could occur with as little as "a single ingestion of the boiled whale internal organs."

Total contaminant level

Mercury (mg.kg⁻¹): 1980; organic mercury: 23.5

(SOURCE: Endo, T., Haraguchi, K., and Sakata, M. 2003. Renal toxicity in rats after oral administration of mercury-contaminated boiled whale livers marketed for human consumption. *Archives Environ. Contam. Toxicol.* 44:412-416)

- Mercury contamination of whale and dolphin "red meat" sold for human consumption exceeded health limits

Cetacean "red meat" sold for human consumption in Japanese retail outlets came from five baleen whale species (including both O and J stock North Pacific minke whales) and nine odontocete species. One of the mysticete samples (from an O stock North Pacific minke whale) exceeded allowable mercury levels in food set by the Japanese government (0.4 mg.kg⁻¹). All of the odontocete samples exceeded this allowable level. The two most contaminated samples exceeded health level limits by 200 and 160 times, respectively. The authors suggested that the frequent consumption of red whale meat could result in "the possibility of chronic intoxication by methylmercury".

Total contaminant level

Mercury (mg.kg⁻¹ wet weight)

Mysticetes: range 0.01-.052; Odontocetes: range 0.52-81

(SOURCE: Endo, T., Hotta, Y., Haraguchi, K. and Sakata, M. 2003. Mercury contamination in the red meat of whales and dolphins marketed for human consumption in Japan. *Environ. Sci. Technol.* 37: 2681-2685)

- Second study records mercury contamination in cetacean products sold for human consumption

Similar to the study above, researchers analysed mercury and cadmium levels in odontocete products intended for human consumption, purchased from Japanese retail outlets. Tissues analysed included boiled liver, lung, kidney and "red meat" and came from: pilot whale, Risso's dolphin, Baird's beaked whale, minke whale (undetermined species/stock), Bryde's whale and indeterminate dolphin and baleen whale species. Boiled liver contained the highest levels of mercury, followed by boiled kidney, lung, and "red meat". Odontocete tissues were more contaminated than mysticete tissues. Mean mercury levels in boiled liver were deemed to be "high enough to cause acute intoxication even from a single ingestion." Maximum liver contamination levels were 1980 mg.kg⁻¹ wet weight. Mean contamination levels in red meat were 22 and 18 times higher than levels permitted by the Japanese government for total mercury (0.4 mg.kg⁻¹ wet weight) and methyl mercury (0.3 mg.kg⁻¹), respectively.

Mean contaminant level

Mercury (mg.kg⁻¹ wet weight)

Liver: 388; "red meat": total mercury 8.84, methyl mercury 5.44

Cadmium (mg.kg⁻¹ wet weight)

Liver: 8.59; kidney: 10.4; lung: 1.66

(SOURCE: Endo, T., Haraguchi, K., Cipriano, F., Simmonds, M.P., Hotta, Y. and Sakata, M. 2004. Contamination by mercury and cadmium in the cetacean products from the Japanese market. *Chemosphere* 54:1653-1662)

- Deep water input of DDT along California coast 30 years after ban

An analysis of DDT concentrations in sediments off the central Californian coast demonstrates that Monterey Bay and other canyons still receive DDT from terrestrial runoff, which is also reflected in bioaccumulation in the biota. This continued input from the shore, 30 years after DDT was banned, underlines the long-term effects of persistent pollutants in the marine environment.

Maximum contaminant levels

Σ DDT ($\mu\text{g}\cdot\text{kg}^{-1}$): ~15

(SOURCE: Hartwell, S.I. 2004. Distribution of DDT in sediments off the central Californian coast. *Mar. Poll. Bull.* In press)

- High levels of radioactive contamination in Sea of Japan

Levels of radioactive plutonium in the Sea of Japan around the Korean Peninsula were higher in the Sea of Japan than the North Pacific, with levels increasing in winter months. Ratios of ^{240}Pu : ^{239}Pu were very high (range 0.18-0.33; mean 0.25), significantly higher than expected due to typical fallout levels. The plutonium ratios were higher than those recorded in the waters around the Bikini Atoll.

Contaminant levels

$^{239+240}\text{Pu}$ in seawater ($\text{mBq}\cdot\text{m}^{-3}$): 3.1-22.3

(SOURCE: Kim, C.K., Kim, C.S., Chang, B.U., Choi, S.W., Chung, C.S., Hong, G.H., Hirose, K. and Igarashi, Y. 2004. Plutonium isotopes in seas around the Korean Peninsula. *Sci. Total Environ.* 318:197-209)

- Antifouling paint herbicides in Japanese coastal waters

Three new antifouling paint booster biocides were investigated in coastal waters of western Japan in August 1999. Diuron was positively identified for the first time in Japanese aquatic environments. Irgarol 1051 was found in concentrations similar to earlier studies, whereas concentrations of M1, the degradation product of the latter, were generally lower than these earlier studies. The results suggest that commercial ship-bottom paints containing both Diuron and Irgarol 1051 are used extensively here. No data on commercial ship-bottom paints used in Japan are available and there is no legislation governing the use of antifouling agents in Japan.

(SOURCE: Okamura, H., Aoyama, I., Ono, Y., and Nishida, T. 2003. Antifouling herbicides in the coastal waters of western Japan. *Mar. Poll. Bull.* 47: 59-67)

- Health risks of high levels of contamination in humpback dolphins

Detailed studies of contaminant levels on Hong Kong's population of humpback dolphins showed high levels of organochlorines, in particular DDT, and mercury contamination. These contaminant levels are high enough to impact humpback dolphin health: half of analysed dolphins stranded in Hong Kong exceed a toxic threshold level above which toxic effects have been recorded to occur in marine mammals; and 44% exceeded blubber PCB concentrations above which increased prevalence of infectious diseases have been recorded in UK cetaceans. DDT contamination was noted in humpback dolphin milk; safe levels of DDT and PCBs could be exceeded for humpback dolphin calves as a result.

Maximum contaminant levels

Hump back dolphins ($\mu\text{g}\cdot\text{g}^{-1}$ lipid weight) Σ HCH: 6.88; Σ Chlordane: 25.4; Σ PCB: 125; Σ DDT: 381

Hg: 906 ($\mu\text{g}\cdot\text{g}^{-1}$ dry weight)

Hump back dolphin milk ($\mu\text{g}\cdot\text{g}^{-1}$ lipid weight) Σ HCH: 1.16; Σ Chlordane: 0.19; Σ PCB: 2.49; Σ DDT: 13.72

(SOURCE: Parsons, E.C.M. 2004. The potential impacts of pollution on humpback dolphins: with a case study on the Hong Kong population. *Aquat. Mamm.* 30:18-37)

- Pyrethroid pesticides currently used in California shown to be toxic to aquatic species

Almost half of the sediments of water systems tested for pyrethroid contamination (a commonly used pesticide in California agriculture) caused significant mortality in test species (which included amphipods). Pyrethroid concentrations appeared to be responsible for the majority of the toxicity, with some toxicity caused by organochlorine contamination. The authors concluded there was a substantial risk to benthic organisms. This study has implications for toxic effects on coastal marine biota and demonstrates unforeseen toxic impacts of currently utilised pesticides.

(SOURCE: Weston, D.P., You, J. and Lydy, M.J. 2004. Distribution and toxicity of sediment-associated pesticides in agricultural-dominated water bodies of California's central valley. *Environ. Sci. Technol.* 38: 2752-2759)

- Dioxins, PCDFs and coplanar PCBs higher in North Pacific than Southern Ocean

Levels of dioxin (PCDD), PCDF and coplanar PCBs in albatrosses were higher in the North Pacific than in the Southern Ocean. Relative proportions of PCDFs and coplanar PCBs were higher in these open ocean birds than in coastal and terrestrial counterparts, suggesting higher transportability by air and water than for dioxins. Toxicity levels (as denoted by TEQs) were also higher in the North Pacific

than in the Southern Ocean. Although the study investigated contaminants in albatrosses, patterns of contamination in these wide-ranging, long-lived, oceanic predators may also be applicable to cetaceans.

Maximum contaminant levels

North Pacific (ng.kg⁻¹ lipid weight) PCDD: 2800; PCDF: 6200; co-planar PCBs: 18.0; TEQs: 6000 mg.kg⁻¹ lipid weight

Southern Ocean (ng.kg⁻¹ lipid weight) PCDD: 170; PCDF: 130; co-planar PCB: 0.35; TEQs: 120 mg.kg⁻¹ lipid weight

(SOURCE: Tanabe, S., Watanabe, M., Minh, T.B., Kunisue, T., Nakanishi, S., Ono, H. and Tanaka, H. 2004. PCDDs, PCDFs, and coplanar PCBs in Albatross from the North Pacific and Southern Oceans: levels, patterns and toxicological implications. *Environ. Sci. Technol.* 38: 403-413)

DISEASE AND MORTALITY EVENTS

-/+ An evaluation of infectious disease threats to killer whales

To identify potential threats to the southern resident stock of killer whales in the northeastern Pacific, 15 infectious agents reported from free-ranging and captive killer whales were identified, as well as 28 infectious agents that have been documented in captive and free-ranging odontocete species that are sympatric with southern resident killer whales. Of the identified infectious agents, the bacteria *Brucella* spp. and pox, morbilli- and herpes viruses were considered to be priority pathogens. This should allow streamlining of necropsy protocols to search for these potential high risk pathogens.

(SOURCE: Gaydos, J.K., Balcomb, K.C., Osborne, R.W., and Dierauf, L. 2004. Evaluating infectious disease threats for southern resident killer whales, *Orcinus orca*: a model for endangered species. *Biol. Conserv.* 117:253-262)

-/+ Differentiated organochlorine contamination levels in northern fur seal pups

The developing mammalian immune system is particularly susceptible to injury from low-level chemical exposure during the perinatal period. In the northern fur seal, the pups of young mother seals had higher mean organochlorine (OC) concentrations than those of older mothers. The higher OC exposure and poor immune responses of such first-born pups, coupled with the potential influence of many confounding factors, underline the challenges associated with conducting toxicological research in free-ranging marine mammals and point to the necessity of examining multiple biomarkers in an integrated fashion. Such rigorous study designs coupled with cutting-edge laboratory techniques are an approach the IWC is currently applying to cetaceans (Pollution 2000+ project).

(SOURCES: Beckman, K.B., Blake, J.E., Ylitalo, G.M., Stott, J.L. and O'Hara, T. 2003. Organochlorine contaminant exposure and associations with hematological and humoral immune functional assays with dam age as a factor in free-ranging northern fur seals (*Callorhinus ursinus*). *Mar. Poll. Bull.* 46: 594-606; and response to above paper by Ross, P.S. 2004. Body condition, rather than contaminants, is likely to explain health effects observed in first-born northern fur seal pups. *Mar. Poll. Bull.* 48: 806-807)

- *Brucella* isolated in North Pacific minke whales

Japanese researchers described testicular lesions in 33% of sampled male North Pacific minke whales harvested in the JARPN scientific whaling program. Blood serum tests were antibody positive in 38% of minke whales of both sexes for the pathogen *Brucella* spp. *Brucella* spp. are of health concern as they are the causative factor of brucellosis in mammals, symptoms of joint and muscle pain, and epididymitis and inflammation of the testis in males and the induction of abortion in females. The high prevalence of this pathogen has implications for minke whale health and fecundity. *Brucella* spp. have also been documented as being capable of causing infections in humans. The high prevalence of *Brucella* in North Pacific minke whales also, therefore, has implications for human health (for both those working with infected carcasses and those consuming contaminated products).

(SOURCE: Ohishi, K., Zenitani, R., Bando, T., Goto, Y., Uchida, K., Maruyama, T., Yamamoto, S., Miyazaki, N. and Fujise, Y. 2003. Pathological and serological evidence of *Brucella*-infection in baleen whales (Mysticeti) in the western North Pacific. *Comp. Immunol. Microbiol. Infect. Dis.* 26:125-136)

- Pinniped pathogen found in a common dolphin in California

Between 1994 and 2004, 141 isolates of *Arcanobacterium phocae* were recovered from marine mammals along the California coast (US). One of these marine mammals was a common dolphin. This is the first report of this pathogen in a cetacean, or other marine mammal, from the Pacific Ocean.

(SOURCE: Johnson, S.P., Jang, S., Gulland, F.M.D., Miller, M.A., Casper, D.R., Lawrence, J., and Herrera, J. 2003. Characterization and clinical manifestations of *Arcanobacterium phocae* infections in marine mammals stranded along the central California coast. *J. Wildlife Dis.* 39:136-144)

CLIMATE CHANGE

+ New method of predicting El Niño

A statistical model, developed by the Ohio State University in conjunction with the US Environmental Protection Agency, allows El Niño to be predicted six months in advance. This approach is based on the strength of westerly winds in a particular location of the tropical Pacific and should allow commercial fishermen, fishery managers and researchers to plan their activities further in advance. (SOURCE: Marine Pollution Bulletin News. 2004. El Niño predictions reach new heights. *Mar. Poll. Bull.* 48: 612)

NOISE IMPACTS

-/+ Killer whales increase call length in response to boat traffic

There has been a five-fold increase in the number of boats attending killer whales in Washington State (US) between 1990 and 2000, with an accompanying increase in boat-related noise. Comparisons were made between killer whale call duration from 1977-81; 1989-92 and 2001-03, and when boats were and were not present. Killer whale call duration increased significantly when boats were present, but only in the 2001-03 time period. The authors suggest this increase in call duration is an adaptive behaviour to overcome masking of biologically important calls by boat-related noise.

(SOURCE: Foote, A.D., Osborne, R.W. and Hoelzel, A.R. 2004. Whale-call response to masking boat noise. *Nature* 428: 910.)

GENERAL

- Great Barrier Reef to be decimated by 2050

A new report predicts that the Great Barrier Reef will lose 95% of its living coral by 2050. This prediction was based on the best-case scenario for estimates of global warming and increases in sea temperatures. Although the reef would ultimately recover through growth of warmer water corals, recovery could take up to 500 years. As the Great Barrier Reef is inhabited by over 1,500 species of fish and 30 species of marine mammal, this has obvious habitat and ecosystem degradation implications for cetaceans in the western Pacific.

(SOURCE: 2004. Hoegh-Guldberg, H., and Hoegh-Guldberg, O. 2004. The Implications of climate change for Australia's Great Barrier Reef. WWF Australia and Queensland Tourism Industry Council, Australia. 349pp.)

- Threatened southern resident killer whales

The annual censuses of the southern resident stock of killer whales in the northeastern Pacific (US) show only a 0.3% annual population increase since 1974. Between 1997 and 2001, the population decreased by 20%. Changes in survival rates suggest an external cause, *e.g.*, changes in prey availability, but no obvious factors have been found that echo changes in survival rates. Possible factors impacting the killer whales include: pollutant contamination causing immunosuppression or reproductive impairment; noise pollution (masking biologically important sounds); or declines in prey species. Although the US government was petitioned to list southern resident killer whales as endangered under the US Endangered Species Act (ESA) in May 2001, the government considered that southern resident killer whales were ineligible for endangered species status: they did not constitute a "species" as defined in the ESA. A lawsuit brought by environmental NGOs resulted in a court ruling requiring the US government to reassess this decision and reconsider the stock for listing.

(SOURCE: Krahn, M.M., Wade, P.R., Kalinowski, S.T., Dahlheim, M., Taylor, B.L., Hanson, M.B., Ylitalo, G., Angliss, R.P., Stein, J.E. and Waples, R.S. 2002. Status review of Southern Resident killer whales (*Orcinus orca*) under the Endangered Species Act. US Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-54. 133pp.)

GLOBAL

HABITAT PROTECTION/DEGRADATION

+ Marine Wildlife Bycatch Mitigation (new book)

The book discusses various bycatch mitigation strategies, including legislation and regulation, monitoring schemes, gear modification, incentive schemes and product labelling. Although concentrating on the situation in Australia, the book reports on various bycatch mitigation strategies around the world and discusses strengths and weaknesses. The final chapter “is an acknowledgement that no single measure can be used to combat bycatch, but rather that a combination of approaches is needed” and presents bycatch reduction case studies at local, regional and international levels.

(SOURCE: Bache, S. 2004. *Marine Wildlife Bycatch Mitigation: Global Trends, International Action and the Challenges for Australia*. Ocean Publications, Wollongong, Australia. 329pp.)

+ Modelling method to ascertain cost effectiveness of bycatch management

To investigate the effectiveness of a bycatch limit to manage bycatch of New Zealand sea lions, the conservation and cost benefits were modelled using two alternative management regimes: unrestricted fishing and no fishing. The modelling exercise determined that the fishery poses little risk to the sea lion population, but there is a marginal risk of extinction if a catastrophic event were to occur. The bycatch limit regime does not reduce this extinction risk in the event of a catastrophe, but is costly; being most expensive when risk is least. This article describes a model that appears to be a good tool for evaluating alternative management strategies against predefined objectives for a marine mammal and is therefore relevant for cetaceans.

(SOURCE: Breen, P.A., Hilborn, R., Maunder, M.N., and Kim, S.W. 2003. Effects of alternative control rules on the conflict between a fishery and a threatened sea lion (*Phocartos hookeri*). *Can. J. Fish. Aquat. Sci.* 60:527-541)

+ New method to assess significant adverse impacts of anthropogenic activities on cetacean behaviour

In a study investigating the impacts of boat traffic on bottlenose dolphins in New Zealand, a Markov chain model was constructed and determined that resting and socialising behaviour were “disrupted by interactions with boats to a level that raises concern”. Although a complicated approach, this statistical tool may be applicable in other instances to assess whether boat traffic or other anthropogenic activities are significantly altering cetacean behaviour.

(SOURCE: Lusseau, D. 2003. Effects of tour boats on the behavior of bottlenose dolphins: using Markov chains to model anthropogenic impacts. *Conserv. Biol.* 17:1785-1793)

- Damage caused by fishing gear degrading marine habitats

This paper suggests that the knowledge of fishermen and scientists be integrated to assess the potential ecological damage caused by fishing gear. Generally mobile, bottom-fishing gears are considered to cause more habitat damage than pelagic gear. The authors recommend that ecosystem-based fisheries management include shifting from damaging to non-damaging fishing gear types. In cases where impacts cannot be addressed by alternative fishing gears and practices, closed areas may be necessary to protect ecosystems and species.

(SOURCE: Chuenpagdee, R., Morgan, L.E., Maxwell, S.M., Norse, E.A. and Pauly, D. 2003. Shifting gears: assessing collateral impacts of fishing methods in US waters. *Front. Ecol. Environ.* 1:517-524)

- Major depletion of world fish stocks and the problems of fisheries management

The UN Food and Agriculture Organisation (FAO) states that “28% of global [fish] stocks are significantly depleted or overexploited, and 47% are either fully exploited or meet the target maximum sustainable yields. Only 24% of global [fish] stocks are either under- or moderately exploited.” The FAO estimates that roughly one-quarter of the commercial catch is thrown back into the sea – wasted as bycatch. It also estimates that illegal, unreported and unregulated (IUU) fisheries exceed fishing quotas by 300%. The paper also discusses the rising issue that uncertainty needs to be incorporated into fisheries models; how environmental changes can have major impacts on fish stocks; how competitors can overtake a depleted species niche making recovery difficult; and that in the northeast Atlantic data are collected on only 55 of 250 species – issues that make full ecosystem-based management difficult at best. Comments on depleted fisheries, in terms of cetacean prey species, and the problems of fisheries management and ecosystem modelling all have relevance to whales and the IWC.

(SOURCE: Gewin, V. 2004. Troubled waters: the future of global fisheries. *PLoS Biol.* 2:422-427)

- Mass mortality of krill

Parasitized krill were found in 7% of stations sampled off the coast of Oregon (US). Hosts were typically killed within 40 hours of infection. Krill infection by similarly deadly parasites has been documented in 68-98% of samples in the Bering Sea. Krill parasites are therefore widespread and parasite-induced mass mortalities in krill may occur more often than previously assumed. This paper indicates another way a major prey source for cetaceans can experience serious levels of mortality other than through predation and starvation.

(SOURCE: Gómez-Gutiérrez, J., Peterson, W.T., De Roberts, A. and Brodeur, R.D. Mass mortality of krill caused by parasitoid ciliates. *Science* 301:339)

CHEMICAL POLLUTION

+ Toxicology of Marine Mammals (new book)

This book provides comprehensive insight into the state-of-the-art knowledge in the different research disciplines devoted to the study of toxicology in marine mammals. The geographic domain is global, with contributions ranging from Arctic ecosystems to the tropics and Antarctica. The overview papers and case studies either treat cetaceans or are directly relevant to cetacean issues. The contributions underline that monitoring the contaminants in marine mammals, combined with monitoring other ecosystem components, provides a tool to quantify environmental loads and ongoing inputs of persistent contaminants. This type of information is one of the multiple tools required to describe and monitor trends in the state of the cetacean environment.

(SOURCE: Vos, J.G., Bossart, G.D., Fournier, M. and O'Shea, T.J. (Eds). 2003. *Toxicology of Marine Mammals*. Taylor & Francis, London. xxxpp.)

+ New dolphin cell line developed – a substitute for tissues from living animals

A new bottlenose dolphin cell line has been developed that could be utilized for ecotoxicological studies into the impacts of contaminants on cetacean tissues as an alternative to experimentation on, or harvesting of, living animals.

(SOURCE: Pine, M., Schroeder, M., Greer, K., Hokanson, R. and Busbee, D. 2004. Generation and partial characterization of a transformed cetacean cell line. *Aquat. Toxicol.* 67:195-202)

-/+ Toxic brominated flame retardants are widespread in the marine environment

This study determined that polybrominated diphenylethers (PBDEs) and other brominated flame retardants are widely distributed throughout the global oceans. The contaminants have even found their way into deep sea biota, as evidence by their presence in sperm whales. These contaminants bioaccumulate and higher levels occur in marine mammals consuming predatory fish. Trend analyses indicate increases in brominated flame retardant levels are slowing down in many areas. Declines in levels, for example may be expected in Europe. Levels are increasing in the Arctic, however, due to production of these chemicals in North America and atmospheric transport of the contaminants.

Maximum contaminant levels

ΣPBDE (µg.kg⁻¹ wet weight) sperm whale, Europe: 263; bottlenose dolphin, Australia: 167

(SOURCE: Law, R.J., Alae, M., Allchin, C.R., Boon, J.P., Lebeuf, M., Lepom, P. and Stern, G.A. 2003. Levels and trends of polybrominated flame retardants in wildlife. *Environ. Internat.* 29:757-770)

- High levels of contaminants in Arctic cetaceans

Some harbour porpoises in northern Norway, some resident killer whales and all transient killer whales in Alaska and some long-finned pilot whales in the Faeroe Islands display levels of PCBs that have induced immunosuppression and reproductive failure in other mammalian species. Reproduction in fish-eating marine mammals, including minke whales, beluga whales and narwhals, long-finned pilot whales and harbour porpoises may be affected as the result of consuming PCB-contaminated fish. Killer whales may exhibit PCB reproductive abnormalities as the result of consuming contaminated seals. Contaminant levels (especially PCBs, DDT and dioxin-like substances) in cetacean prey species (fish and molluscs) should be considered and monitored when managing and issuing guidelines to protect marine species.

(SOURCE: De Wit, C., Fish, A., Hobbs, K., Muir, O., Gabrielsen, G., Kallenborn, R., Krahn, M.M., Norstrom, R. and Skaare, J. 2004. *AMAP Assessment 2002: Persistent Organic Pollutants in the Arctic*. Arctic Monitoring and Assessment Program, Oslo Norway)

- Ecosystem and trophic changes as the result of indirect contaminant effects

A review of 150 studies on the indirect impacts of contaminants on marine species reported a variety of contaminant-induced effects including changes in: behaviour; competition; and grazing/predation rate. These effects can alter abundance or community composition. Trophic cascade effects were

documented in 60% of cases, most notably increases in phytoplankton due to a reduction in herbivores. The review indicated major changes in ecosystems and trophic systems can occur as the indirect result of contaminant effects.

(SOURCE: Fleeger, J.W., Carman, K.R. and Nisbet, R.M. 2003. Indirect effects of contaminants in aquatic ecosystems. *Sci. Total Environ.* 317:207-233)

- Marine animals accumulate higher levels of arsenic than land animals

Research conducted on arsenic levels in marine species, including marine mammals, noted that these species contain and accumulate higher levels of arsenic in their tissues than terrestrial animals.

Although cetaceans were not specifically examined, the findings of this study are likely applicable to cetaceans, *i.e.*, they may be predisposed to accumulate high levels of the toxic trace element arsenic.

(SOURCE: Fujihara, J., Kunito, T., Kubota, R. and Tanabe, S. 2003. Arsenic accumulation in livers of pinnipeds, seabirds and sea turtles: subcellular distribution and interaction between arsenobetaine and glycine betaine. *Comparative Biochemistry and Physiology Part C* 136:287-296)

- Widespread impacts of marine pollution

This paper reviews and summarizes the various forms of aquatic pollution and their impacts on the ecosystem and organisms. It forecasts significant ecological/public health risks in the coming years, especially in developing countries. Pollution has already caused major changes in the structure and function of marine communities and has already damaged most of the world's important fisheries to varying extents. This information is relevant to a range of cetacean-related issues.

(SOURCE: Islam, M.S. and Tanaka, M. 2004. Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis. *Mar. Poll. Bull.* 48: 624-649)

- New persistent chemicals threaten wildlife

A World Wildlife Fund report, "Causes for Concern: Chemicals and Wildlife," highlights perfluorinated compounds, phthalates, phenolic compounds and brominated flame retardants (BFRs) as the most prominent new toxic hazards. Perfluorinated compounds, classified as cancer-causing chemicals by the US Environmental Protection Agency, have been found in dolphins and whales in the Mediterranean; BFRs have been found in sperm whales in the Canadian Arctic.

(Source: Marine Pollution Bulletin News. 2004. Persistent chemicals still threaten wildlife. *Mar. Poll. Bull.* 48: 413)

- Perfluorinated organochemicals (PFOs) found in cetaceans

Perfluorinated organochemicals (PFOs) were detected in various marine mammal species in the North Sea. The paper has global importance, however, as an introduction to the prevalence of this contaminant in marine mammals. Data suggest that these chemicals may bioaccumulate. The chemicals are not found in the blubber layer, as they bind to blood proteins, but can be found in underlying muscle tissue. Inshore species and species occupying higher trophic levels displayed higher levels of PFOs. The effects of these contaminants on marine mammals are as yet unknown.

(SOURCE: Van de Vijver, K.I., Hoff, P.T., Das, K., van Dongen, W., Esmans, E.L., Jauniaux, T., Bouquegneau, J-M., Blust, R. and de Coen, W. 2003. Perfluorinated chemicals infiltrate ocean waters: link between exposure levels and stable isotope ratios in marine mammals. *Environ. Sci. Technol.* 37:5545-5550)

- Consumption of mercury-contaminated whale meat and fish lead to developmental problems in children

A 14-year study conducted in the Faeroe Islands suggests that pre-natal exposure to methylmercury can cause disruption of brain development in children. These developmental problems may be irreversible. The problems are exacerbated by subsequent consumption of methylmercury contaminated products. Certain fish and particularly pilot whale meat are major sources of this toxic compound.

(SOURCE: Murata, K., Weihe, P., Budtz-Jørgensen, E., Jørgensen, P.J., Grandjean, P. 2004. Delayed brainstem auditory evoked potential latencies in 14-year-old children exposed to methylmercury. *J. Pediatr.* 144:177-183)

DISEASE AND MORTALITY EVENTS

+ An alternative disease research method

Severe combined immunodeficient (SCID) mice were injected with cetacean white blood cells and canine distemper virus vaccine. Cell-mediated immune responses occurred in some of the mice. This study indicates a method by which the effects of pathogens on cetaceans could be investigated in SCID mice, as opposed to experimentation on living cetaceans.

(SOURCE: DeGuise, S. and Levin, M.J. 2004. Cetacean-reconstituted severe combined immunodeficient (SCID) mice respond to vaccination with canine distemper virus. *Veterinary Immunology and Immunopathology* 97:177-186)

+ Whale health assessed from aerial photographs

North Atlantic right whale health and body condition were assessed from aerial photographs. This method could easily be translated to other whale species of concern, e.g. western Pacific gray whales. (SOURCE: Pettis, H.M., Rolland, R.M., Hamilton, P.K., Brault, S., Knowlton, A.R. and Kraus, S.D. 2004. Visual health assessment of North Atlantic right whales (*Eubalaena glacialis*) using photographs. *Can. J. Zool.* 82:8-19)

- High levels of toxoplasmosis in Atlantic dolphins

The pathogen *Toxoplasma gondii*, a known cause of marine mammal mortality, is highly prevalent in Atlantic bottlenose dolphins. The source of this pathogen is likely to be cat excrement flushed out into the marine environment in sewage or via runoff. Also prevalent is *Neospora caninum*, a causative agent of encephalitis in livestock. The only known host for this pathogen is dogs – again, sewage or runoff may be a source. The results of the paper suggest that exposure in dolphins to pathogens that are indirectly anthropogenic in source is substantial.

(SOURCE: Dubey, J.P., Zarnke, R., Thomas, N.J., Wong, S.K., Van Bonn, W., Briggs, M., Davis, J.W., Ewing, R., Mense, M., Kwok, O.C.H., Romand, S. and Thulliez, P. 2003. *Toxoplasma gondii*, *Neospora caninum*, *Sarcocystis neurona*, and *Sarcocystis canis*-like infections in marine mammals. *Veterinary Parasitology* 116: 275-296)

- Premature halt in recovery of marine mammals may be due to damaged ecosystems

Antarctic fur seals numbers, after a previously high period of growth, are now stabilizing (reaching carrying capacity), despite fur seal numbers being an order of magnitude lower than pre-exploitation levels. The authors suggest that “the near-extinction of parts of various components of the [Antarctic] ecosystem” and population stabilizations may be a response to extensive exploitation of marine resources in the Antarctic region. The results of this study imply that lack of recovery in some cetacean populations may be due to degradation of ecosystems.

(SOURCE: Hucke-Gaete, R., Osman, L.P., Moreno, C.A. and Torres, D. 2004. Examining natural population growth from near extinction: the case of the Antarctic fur seal at the South Shetlands, Antarctica. *Polar Biology* 27: 304-311)

- High rate of spread in marine pathogens

An analysis of the rate of spread of pathogens demonstrated that marine viruses spread extremely quickly; for example, herpes virus spread through pilchard populations at a rate greater than 10,000km per year and morbillivirus spread through cetacean populations at a rate of 3000km per year. In comparison, only myxomatosis in rabbits and West Nile Virus in birds have spread at a rate greater than 1000km per year. Marine pathogens have the potential for long term survival outside of the host, and the marine environment does not contain major barriers to dispersal, unlike terrestrial environments.

(SOURCE: McCallum, H., Harvell, D. and Dobson, A. 2003. Rates of spread of marine pathogens. *Ecol. Letters* 6:1062-1067)

- Increases in reports of marine disease outbreaks

Researchers analysed reports of disease in nine marine taxonomic groups from 1970 to 2001. The discovery of reports was normalized for search effort. It was found that disease reports had decreased in fish. No trends were noted for seagrasses, decapods or sharks/rays. Increases in disease reports were noted turtles, corals, urchins and mollusks. Increases in disease reports were also noted for marine mammals.

(SOURCE: Ward, J.R. and Lafferty, K.D. 2004. The elusive baseline of marine disease: are diseases in the ocean ecosystems increasing? *PLoS Biol.* 2: 542-547)

CLIMATE CHANGE

- Mass Balance Of the Cryosphere (new book)

This book provides comprehensive insight into the state of the frozen water on our planet, looking at the Arctic and Antarctic regions, Greenland, glaciers and sea ice. Ice around the world is melting at an alarming rate as global temperatures increase. This could have radical implications for the future global climate. Potential changes in ocean currents, for example, could also dramatically impact cetaceans.

(SOURCE: Marine Pollution Bulletin News. 2004. Warnings on disappearing ice. *Mar. Poll. Bull.* 48: 205. *Mass Balance of the Cryosphere: Observations and Modelling of Contemporary and Future Changes.* 2004. J.L. Bamber & A.L. Payne (Eds). Cambridge University Press)

- Ozone hole reaches record size

According to the United Nation’s World Meteorological Organization the hole in the ozone layer over Antarctica has reached a record 10.8 million square miles.

(SOURCE: Anonymous. 2003. Ozone hole reaches record size. *Ecologist* 33(9): 7)

- Evidence for ozone depletion causing other climatic change

Simulations of atmospheric changes reinforce the idea that ozone depletion has played an important role in climatic changes in the southern hemisphere, including temperature changes and alteration in surface winds. This would have implications for climate and oceanography of the Antarctic region and southern hemisphere, and hence major cetacean habitats.

(SOURCE: Gillett, N.P. and Thompson, D.W.J. 2003. Simulation of recent southern hemisphere climate change. *Science* 302:273-275)

- Melting glaciers contributing to sea level rise

Melting of glaciers in Argentina and Chile has doubled in recent years and increased meltwater is entering coastal areas and is sufficient to cause increases in sea level. This global warming-induced effect could cause hydrological changes in coastal ecosystems and cetacean habitats.

(SOURCE: Rignot, E., Rivera, A. and Casassa, G. 2003. Contribution of the Patagonian icefields of South America to sea level rise. *Science* 302:434-437)

- Amount of solar radiation reaching earth surface is decreasing

Research has suggested that the amount of solar radiation reaching the earth's surface may have decreased by 10% between 1960 and 1990. Aerosol pollutants in the atmosphere may be increasing atmospheric droplet formation, thereby reducing penetration of solar radiation. These atmospheric droplets are too small to build up enough water mass to condense, trapping moisture in the atmosphere. Although the exact amount of dimming is debated (e.g., only 4% in three decades according to one study), the issue may constitute a new and major anthropogenic climatic effect. The impacts on cetaceans could include minor hydrological and oceanographic changes, or potentially a reduction in sunlight available for phytoplankton and more major impacts on oceanic ecosystems.

(SOURCE: Nash, H. 2004. Ozone hole reaches record size. *Time* 163(21): 60)

- Ice core studies show decline in Antarctic sea ice cover

Satellite images have not found a significant decrease in sea ice extent in Antarctica, due to large 11-year cyclical variations in ice cover and a relatively short satellite image data set (22 years worth). However, calibrating methanesulphonic acid concentrations in ice cores with satellite images allowed long-term (from 1841 to 1995) calculation of sea ice extent. This analysis determined that there has been a 20% decrease in sea ice extent since the 1950s. This decrease in sea ice has major implications for the Antarctic ecosystem and cetaceans.

(SOURCE: Curran, M.A.J., Van Ommen, T.D., Morgan, V.I., Phillips, K.L. and Palmer, A.S. 2003. Ice core evidence for Antarctic sea ice decline since the 1950s. *Science* 302:1203-1206)

- World's oceans becoming more acidic

Oceanic pH after the last ice age was 8.3 and is now 8.1. The cause of this increasing acidity is believed to be increasing atmospheric CO₂ concentrations. The authors modelled increasing levels of CO₂ based on population and economic growth, with a decrease after the exhaustion of fossil fuels. Atmospheric CO₂ peaked at five times current levels. These CO₂ levels were predicted to result in a drop of oceanic pH to 7.4 by 2300 and stay at this level for several hundred years. The impacts of this increasing acidity on marine ecosystems (and cetaceans) are unknown, but animals with calcareous exoskeletons or shells (coral, bivalves, some algae) may be most vulnerable.

(SOURCE: Caldeira, K. and Wickett, M.E. 2003. Anthropogenic carbon and ocean pH. *Nature* 425: 365)

- Human influence responsible for climate change since 1950 in North America

Surface temperature variation in the 20th century was analysed for North America in conjunction with climatic models. Although climatic warming from 1900 to 1949 was probably due to natural climate change, natural climate change could not account for increases since 1950. Increased temperatures since 1950 are consistent with patterns of increasing anthropogenic greenhouse gases and sulphate aerosols. This is yet more evidence showing that current climate change and global warming are both anthropogenic and unnatural.

(SOURCE: detection of a human influence on North American climate. *Science* 302: 1200-1203)

- Oceanic productivity has dropped in the last two decades

Satellite-gathered records of chlorophyll levels indicate that oceanic primary productivity has dropped by 6% since the 1980s. Nearly 70% of the global decline occurred in the high latitudes. In the northern high latitudes, these reductions in primary production corresponded with increases in sea surface temperature and decreases in atmospheric iron deposition to the oceans. In the Antarctic, the reductions were accompanied by increased wind stress. These results "indicate that ocean photosynthetic uptake of

carbon may be changing as a result of climatic changes and suggest major implications for the global carbon cycle”.

(SOURCE: Gregg W. W., Conkright, M. E., Ginoux, P., O'Reilly, J. E. and Casey, N. W. 2003. Ocean primary production and climate: global decadal changes, *Geophys. Res. Lett.* 30: 1809)

NOISE IMPACTS

+ Court restricts use of US Low Frequency Sonar

A federal judge granted a permanent injunction restricting the use of the US Navy's Low Frequency Active (LFA) sonar system, due to its potential impacts on cetaceans and other marine life. The injunction was granted primarily due to deficiencies in the US Navy's environmental impact analysis for the sonar system. The US Navy can still use the sonar system in limited areas (in 2003-2004, off the coasts of China and Korea), and in event of war and national emergency.

(SOURCE: Anonymous. 2004. Navy limits sonar to save whales. *Current Science* 89(10): 13 and Malakoff, D. 2003. Judge blocks navy sonar plan. *Science* 301: 1305)

-/+ Human-Generated Ocean Sound and the Effects on Marine Life (special journal issue)

A special issue of the *Marine Technology Society Journal* debates the issue of the impacts of sound on marine life, primarily cetaceans. Papers in this special issue include: Factors that may affect the responses of cetaceans to acoustic disturbance; the impacts of seismic surveys on marine mammals; the problems of predicting ship-based noise; an overview of various cetacean and noise-related issues and court cases in the US; and an oil and gas industry perspective on the noise issue.

(SOURCE: Merrill, J. (ed) 2003. Human generated ocean sound and the effects on marine life. *Mar. Technol. Soc. J.* 37. 105pp.)

- Decompression sickness-like effects in beaked whales and other species after exposure to sonar

Three species of beaked whales stranded on 24 September 2002 after a naval exercise in the Canary Islands showed widespread gas bubble lesions that broadly resembled those found as the result of decompression sickness (“the bends”) in humans. At least four other species from the UK were also found with similar gas bubble lesions. The sonar used in the Canary Islands may have physically induced gas bubbles in tissue or altered the beaked whales' behaviour in a way (e.g., caused an unusually rapid ascent) that assisted in bubble formation – or a combination of both. The authors suggest that gas bubble formation may be exacerbated in deep-diving cetaceans because their blood supplies contain super-saturated levels of dissolved nitrogen.

(SOURCE: Jepson, P., Arbelo, M., Deaville, R., Patterson, I.A.P., Castro, P., Baker, J.R., Degollada, E., Ross, H.M., Herráez, P., Pocknell, A.M., Rodríguez, F., Howie, F.E., Espinosa, A., Reid, R.J., Jaber, J.R., Martin, V., Cunningham, A.A. and Fernández, A. 2003. Gas-bubble lesions in stranded cetaceans: was sonar responsible for a spate of whale deaths after an Atlantic military exercise? *Nature* 425:575-576 and Fernández, A., Arbelo, M., Deaville, R., Patterson, I.A.P., Castro, P., Baker, J.R., Degollada, E., Ross, H.M., Herráez, P., Pocknell, A.M., Rodríguez, F., Howie, F.E., Espinosa, A., Reid, R.J., Jaber, J.R., Martin, V., Cunningham, A.A. and Jepson, P. 2004. Whales, sonar and decompression sickness. *Nature* 428:1-2)

- Wind farm construction negatively impacts harbour porpoise behaviour

Harbour porpoise acoustic activity was monitored before and during construction of a 166 MW wind farm in the western Baltic Sea. Harbour porpoises were less frequently encountered acoustically during the construction of the wind farm. The study determined that during wind farm construction harbour porpoise behaviour had been significantly and negatively affected. In addition, during pile driving activity, harbour porpoises were excluded from the study area for 27 hours before returning. This indicates an extremely negative reaction to the noise produced by pile driving activity. This documents the first study looking at the actual effects of the disturbance caused by wind farm construction on cetaceans.

(SOURCE: Henriksen, O.D., Carsten, J. and Teilman, J. 2004. Impact on harbour porpoises from the construction of the Nysted wind farm in Denmark. Poster presentation at the 18th Annual Conference of the European Cetacean Society, Kolmården, Sweden)

- Low frequency wind turbine noise causes changes in harbour porpoise behaviour

A controlled exposure sound playback experiment simulating the noises produced by a 2 MW wind turbine (frequency <800 Hz) caused harbour porpoise distances between surfacings and distance away from the sound source to significantly increase. The noise exposure also resulted in a significant increase in echolocation rates. However, no obvious exclusion of the porpoises from the area around the sound source was noted. This study demonstrated that harbour porpoises are able to detect low frequency noise, despite audiograms suggesting that they have extremely poor hearing below 1 kHz.

(SOURCE: Koschinski, S., Culik, B.M., Henriksen, O.D., Tregenza, N., Ellis, G., Jansen, C. and Kathe, G. 2003. Behavioural reactions of free-ranging porpoises and seals to the noise of a simulated 2 MW windpower generator. *Mar. Ecol. Progress Series* 265:263-273)

- Seismic survey noise masking whale calls

Hydrophones placed on the mid-Atlantic ridge recorded not only whale calls but also a high level of noise resulting from airguns used in seismic surveys. These seismic survey-related noises were being detected 3000 miles or more from their source. The airguns were detected on all of the hydrophones being used in the study, and airguns were usually heard every 10-20 seconds. Although whales could be detected vocalising when airguns were active, occasionally “the array recorded airguns from more than one location, masking cetacean sounds and on four occasions making the spectrogram impossible to use.” Seismic survey-related noise increased in summer months, but was heard primarily from late spring until autumn. Recording of whale calls peaked in the winter months and the authors suggested that “calls are produced in the summer months but are obscured by airguns.”

(SOURCE: Niekirk, S.L., Stafford, K.M., Mellinger, D.K., and Dziak, R.P. and Fox, C.G. 2004. Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. *J. Acoust. Soc. Am.* 115: 1832-1843)

- Seismic survey airguns harm fish

Fish exposed to a seismic survey airgun sustained damage, at times severe, to cells in their auditory tissues. The damage showed no signs of healing 58 days after exposure. Although noise and cetaceans have received a lot of interest, this paper has implications for the effects of noise on cetacean prey species and marine ecosystems.

(SOURCE: McCauley, R.D., Fewtrell, J. and Popper, A.N. 2003. High intensity anthropogenic sound damages fish ears. *J. Acoust. Soc. Amer.* 113:638-642)

GENERAL

+ US Commission on Oceans Policy issues draft report

The Preliminary Report of the US Commission on Ocean Policy was issued in April 2004. The report is available from <http://www.oceancommission.gov>. The report calls for reorganizing how US research funding is managed, and a doubling increase in US oceanic research expenditure. Other noted projects include monitoring of fisheries and climatic issues and research on the relationship between the oceans and human health.

(SOURCE: Gewin, V. 2004. Panel seeks fresh course for ocean research. *Nature* 425:787)

+ Using age structure to detect impacts on threatened marine mammal populations

An analysis of Steller sea lion population trends incorporated population size, newborn numbers based on aerial photographs, and information on the proportion of juveniles into matrix models. The analysis determined adult and juvenile survivorship and fecundity. The researchers determined that information on the juvenile fraction of the population improved the speed and certainty with which demographic changes were detected. Although a pinniped study, this is a statistical tool that could possibly be used for cetacean populations as well.

(SOURCE: Holmes, E.E. and York, A.E. 2003. Using age structure to detect impacts on threatened populations: a case study with Steller sea lions. *Conserv. Biol.* 17:1794-1806)

- US amends marine mammal protections

On 25 September 2003, the US House of Representatives' Committee on Resources passed a reauthorisation of the US Marine Mammal Protection Act (MMPA) that would reduce restrictions on government agency activities that might impact marine mammals. In addition, the US Department of Defense (DOD) Authorization Bill introduces changes in the MMPA that exempt the US Navy from the statute when conducting activities such as using sonar (in US and international waters). Exemptions also extend to US government-funded researchers. Some scientists support the changes as they will make it easier for some researchers to obtain permits for certain research activities. However, other scientists and other concerned constituencies are concerned about potential wide-ranging implications of easing permit restrictions. These changes in law will have implications for the protection of all cetaceans that may be encountered during US government and military activities in US waters, the high seas and foreign waters (including non-US EEZs).

(SOURCE: Dalton, R. 2003. Scientists split on regulations on sonar use. *Nature* 425: 549 and Kaiser, J. 2003. Military wins changes that may ease research. *Science* 302: 1487-1488)

- Current human activities are not sustainable

This paper discusses an analysis that indicates humans are ecologically abnormal and thus cause major (negative) ecosystem impacts. It states that human “population size, CO₂ production, energy use, biomass consumption and geographical range size differ from those of other species by orders of magnitude.” Of particular relevance to cetaceans, biomass consumption by human fisheries is a “systematic index of excessive harvesting.” The study compares the consumption of marine biomass of

humans to that of 54 species of marine mammals indicating that consumption by humans is statistically greater than those species of marine mammals, exceeding the greatest marine mammal biomass consumer by an order of magnitude.

(SOURCE: Fowler, C.W. and Hobbs, L. 2003. Is humanity sustainable? *Proceedings of the Royal Society of London* 270:2579-2583)

- Human impacts on ecosystems may be more severe than previously thought

This paper discusses five major shifts in perspective “that reveal [human] impacts [on ocean ecosystems] to be more severe and persistent than previously appreciated”. (1) Historical analyses indicate that “the global expansion of European nations across the planet caused a large scale loss of marine megafauna.” Also in the past century the expansion of industrial fishing has continued the process, massively reducing the biomass of exploited fish species. (2) The paper concludes that, once depleted, marine populations do not rebound rapidly, as was previously believed. (3) Marine ecosystems are being shifted into less desirable states from the human perspective, from which it may be difficult or impossible to recover. (4) There is a high risk of extinction for many marine species, and shallow water marine habitat loss is “proceeding as rapidly as on land”. (5) Technological advances are allowing exploitation of deep sea resources and inevitable collateral habitat degradation. To reverse these trends, to protect biodiversity and to stimulate the recovery of the world’s fisheries, the author suggests the instigation of “large-scale networks of marine reserves that are off limits to damaging activities and fishing.”

(SOURCE: Roberts, C.M. 2003. Our shifting perspectives on the oceans. *Oryx* 37:166-177)

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