Industrial and military activities

Dangerous long-lasting radioactive pollution and persistent organic pollutants from military and industrial activities have been building up in the oceans since the Second World War, reports **KAY WEIR**. Moruroa Atoll in the South Pacific is a particular concern with its very large radionuclide contamination from 21 years of underground nuclear test explosions and its potential to leach into the South Pacific Ocean. Scientists warn that the ocean depths may face dangers from long-term contamination as toxins accumulate at very high levels in algae and krill. Ongoing research and monitoring of the many stressors on the oceans is essential.

> *The ultimate receptacle of earth's pollution, whether of the air, land or water, is the oceans. Toxic non-biodegradable plastics and other chemicals, herbicides, pesticides and radioactive material have been heedlessly generated by human military activities since 1945. It is slowly beginning to accumulate in the oceans.*

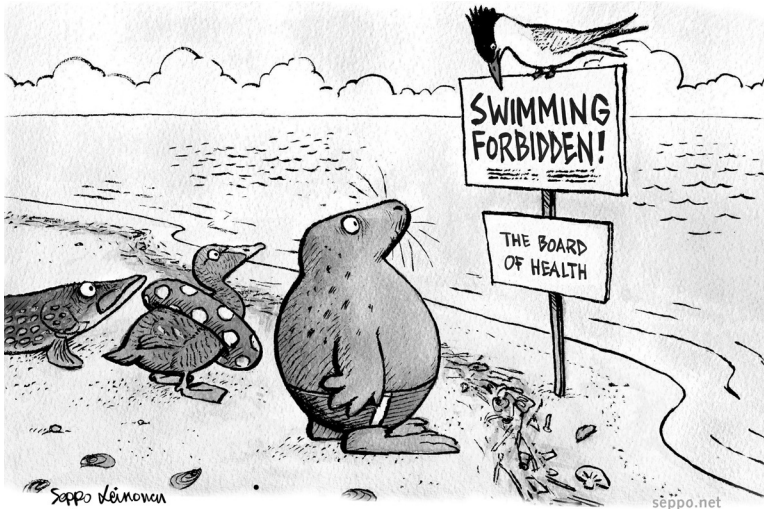
So said Rosalie Bertell, scientist and trenchant critic of the nuclear industry in May 1984 at a conference in Stockholm, Sweden.[1] She went on to say:

> *Unfortunately, to reduce costs the military frequently invents a commercial spin-off of its products. Such innocent items as styrofoam cups are made from packaging material designed to separate the fission and fusion components of a thermonuclear device. All this military debris justified under the umbrella of 'national' security is causing global ecological disaster.*

Manufacturing and testing nuclear weapons requires uranium mining, enrichment plants, nuclear power plants, reprocessing plants and other support industries, each producing their radioactive "permissible" effluence and waste, Dr Bertell reported. The Space Programme, and nuclear-powered ships which routinely discharge toxic radioactive chemical debris into the oceans, poison marine life; under-water and under-ground nuclear testing, and missile testing, have all contributed to the toxic load on the oceans.

Seaweed, such as kelp was found to be very good at concentrating nuclear fission products in its cells after the atomic bombing of Nagasaki and was used to help radiation sufferers. Plankton also absorbs and concentrates insecticides and toxic hydrocarbons. Phytoplankton, at the base of the marine food web sustains all life on earth. "*If we poison it, it will in turn poison the fish and drastically reduce the protein available to sustain mammalian life*," said Dr Bertell. Because of long-lasting dangers and risks for life caused by widespread nuclear pollution of the oceans and earth, Dr Bertell in 1984 recommended at the Stockholm conference:[1]

- An immediate end to all polluting activity, both military and commercial
- A permanent ban on radioactive waste dumping in the oceans, as it's not safe
- A network of internationally sponsored radiobiology laboratories to test marine life on a routine basis and to inform the public and check the food chain for radioactivity.
- Cessation of military use of the oceans in order to protect a key source of human food
- An end to secrecy and inaccurate information on nuclear matters.



"The ultimate receptacle of earth's pollution, whether of the air, land or water, is the oceans. Toxic non-biodegradable plastics and other chemicals, herbicides, pesticides and radioactive material have been heedlessly generated by human military activities since 1945. It is slowly beginning to accumulate in the oceans." – Rosalie Bertell

poisoning the oceans

Her advice was ignored. A year later, in July 1985, France blew up the Rainbow Warrior, the Greenpeace nuclear protest ship in Auckland harbour in New Zealand, showing the lengths it was prepared to go to deter opposition to its secretive underground testing of nuclear weapons on tiny Pacific atolls. Dumping nuclear waste into the oceans routinely continues into the 21st century, despite the London Convention in 1994 banning disposal of dangerous radioactive waste at sea. Monitoring for radioactivity in the marine environment rarely occurs as authorities, like the International Atomic Energy Agency (IAEA) consider radiation risks to be insubstantial. The general idea is that radioactive pollution will be dispersed in the vastness of the oceans.

Ignorance is not bliss

What makes it difficult for authorities like the IAEA to act in the interests of the health of the planet is that its core mandate is to support the nuclear power industry. The question is, how long can the oceans continue to absorb endless amounts of very long-lasting, life threatening toxic waste produced by industrial societies, without reaching a tipping point? Will the sea become so toxic that marine life starts to decline, or could a sudden extinction occur? Will humans suddenly decline?

Industrialised nations have been producing nuclear waste from both civilian and military power generation and weapons production since the 1940's. The US was the first to dump nuclear waste at sea in 1946. During the Cold War, the Soviet and American militaries had hundreds of serious accidents including nuclear armed or propelled ships sunk at sea. At least 11 nuclear reactors and 50 war heads from nuclear submarines litter the sea floor, the *Bulletin of Atomic Scientists* reported in 1989.[2] In 1965 a US plane loaded with nuclear weapons fell into the sea off an aircraft carrier.[2] In 1978 Britain secretly dumped at sea nuclear waste from its nuclear weapons tests in Australia.[3]

The Yablokov report[4] of 1993 openly revealed the Soviet Union dumped eighteen nuclear reactors from nuclear submarines and a nuclear ice-breaker, six containing highly radioactive fuel, into the shallow waters of the Arctic Ocean, the Sea of Japan, the Barents Sea, and the Kara Sea. Vitaliy Lystsov, then deputy director of the Russian Ministry of Environment, who helped prepare the report, said the reactor material is shielded by a mix of special polymers, cement, and other compounds. The protective coating is supposed to keep the radiation sealed off from the marine environment for at least five centuries. Yet no one has examined the shield to see if it's holding up, Kristin O'Grady-Moore notes in her paper, Nuclear Waste Dumping in the Oceans.[5] The Yablokov report frankly admits: "*[The] container material is subject to corrosion. Metal containers fail in seawater after 10 years, and concrete ones in 30 years.*"

In 1986, the **Chernobyl catastrophe** awakened the world to the extraordinary dangers of nuclear power stations. This year on 26/4/2011, the 25th anniversary of the Chernobyl disaster, Ukraine's President Viktor Yanukovych reported that Chernobyl's destroyed nuclear reactor is still a serious threat to Europe, being encased in a deteriorating shell with internationally funded work to replace it far behind schedule. He also said two million people have illnesses caused by radiation, and the catastrophe is estimated to have caused over 700,000 early deaths. A book published in 2009 confirms this. *Chernobyl: Consequences of the Catastrophe for People and the Environment*,[6] published by the New York Academy of Sciences, concludes nearly a million people have already died, mainly of cancer between 1986 and 2004 as a result of the accident and the deaths will continue. Meanwhile in 2006, the IAEA and other UN agencies put the total predicted number of deaths due to Chernobyl at 4000, with an additional 5000 deaths possible.[7]

On 15 May, Japan Today reported the reactor's fuel in Unit 1was found to have largely melted, and was already in a critical state early on 12 March

Recently, the unprecedented explosions at nuclear reactors in **Japan's Fukushima-Daiichi Nuclear Power Plant**, starting on 11 March 2011 again highlights the vulnerability and wide-spread dangers of nuclear power stations. Innundating seawater from the a tsunami after a massive earthquake, disabled emergency generators, cutting the electric power and disabling cooling systems, vital for the safety of nuclear plants. Explosions from four reactors and dangerous radioactive releases to the atmosphere and ocean resulted. On 15 May, *Japan Today*[8] reported the reactor's fuel in Unit 1was found to have largely melted, and was already in a critical state early on March 12. The meltdown had occurred in Unit 1 from the start, but was not reported until two months later.

The bizarre attitude to the oceans as a safe haven for radioactive toxic waste was displayed early when

SOME LONG-LASTING DANGEROUS RADIOACTIVE ISOTOPES

Plutonium, the most common isotope: Pu-239 half life over 24,000 years; Pu-242 half life 346,000 years. Plutonium is very carcinogenic causing bone cancer and leukemia, emits heavy alpha radiation particles that can be stopped by skin and clothes but which are very dangerous in the body. Like other forms of ionising radiation, alpha particles can disrupt the activity of biological cells and damage DNA, and lead to cancers. Plutonium dust in the atmosphere can be breathed in and become lodged in the lungs, or the metal can get into food supplies or drinking water, where it can be ingested by people or animals.

Uranium-238 half life 4.45 billion years; uranium-235 half life 704 million years; uranium- 234 half life 245,000 years, uranium is a heavy metal and can be inhaled or ingested into the body inducing kidney cancer or bone cancer and leukemia.

Cesium-137 half life 30 years, radioactive for 600 years, carcinogenic, concentrates in animal muscles and fish irradiating muscle cells and organs nearby.

Strontium-90 half life of 30 years, radioactively dangerous for 600 years, it mimics calcium if contaminated milk is drunk and can be absorbed into the body causing bone cancer or leukemia years later.

SOURCE: NUCLEAR POWER IS NOT THE ANSWER BY HELEN CALDICOTT

experts assured us the dangers were likely to be low as most of the radiation was blown out to sea on prevailing winds and the ocean circulation would "disperse" contaminants. As Japan's people depend greatly on fish for food and export the claims appear deceptive. In April a ban on fishing was reported within a 20-kilometre radius, as government set limits for the first time on the amount of radiation permitted in fish. Authorities still insisted the radioactive water would dissipate and posed no immediate threat to sea creatures or people who might eat them.[9]

A non-government organisation in Tokyo had a different view. In the magazine *Nuke Info Tokyo*,[10] March/April 2011, Philip White wrote:

> *The truth is that even in the best-case scenario the environmental and human consequences of this disaster will be enormous. The potential impact of a worst-case scenario is beyond most people's comprehension. To give an indication of the amount of radioactive material involved, the total capacity of the three reactors that were operating at the time of the earthquake was double that of the Chernobyl reactor that exploded 24 years ago in the Ukraine. To this you have to add the radioactivity in the spent fuel pools of all 6 units and of the shared spent fuel pool. All of this is at risk and, due to the long-term heat generating properties of the fuel the situation will not be stabilized any time soon. Even if the radioactivity does not travel far, the release of just a fraction would have incalculable consequences for human beings and the environment.*

On 5 May the conservative IAEA reported: "*Overall, the situation at the Fukushima-Daiichi nuclear power plant remains very serious.*"

Nuclear plants pollute oceans

The Sellafield Nuclear Plant, situated on the North-west Coast of England on the Irish Sea, has a very poor safety record with several serious accidents and at one stage daily releases of dangerous radioactive substances over many years into the environment.[11,12] The Irish Sea is said to be one of the most heavily contaminated seas in the world. The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) reports an estimated 200 kilograms of plutonium has been deposited in marine sediments in the Irish Sea.[13] Leukemia risks to children aged 0–4 in coastal areas of Wales adjacent to the Irish Sea are reported to be over four times that expected, based on national figures for England and Wales.[14] Pollution from Sellafield is the likely cause. Ireland also reports higher levels of leukemia in children living near Sellafield.

Norway has repeatedly expressed concerns about security and safety at Sellafield and the large quantities of liquid radioactive waste stored there. In March 2009, the Norwegian Radiation Protection Authority published a report[15] considering the possibility of an accident involving storage tanks of highly active liquid waste at Sellafield containing large quantities of radioactive waste from several decades of reprocessing spent nuclear fuel. Release of only 1% of the tanks' contents, the report says, could result in levels of radioactive fallout in Western Norway five times higher than those measured in the worst affected areas of Norway after the Chernobyl accident. Norwegian authorities consider that in the worst case, an accident at Sellafield could have significant impacts on Norway's agriculture, the environment and society for decades to come.

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A 2006 study, *The Baltic Sea is Radioactive*,[16]

from the Swedish Environmental Movement's Nuclear Waste Secretariat, reports the Baltic is one of the most radioactive seas in the world. The greatest historical causes are the Chernobyl accident, and the UK's Sellafield nuclear plant with its "enormous discharges," despite the great distance from the UK. Knowing the Baltic is already highly radioactive is a very good reason to stop future radioactive releases, the Swedish study remarks.

Coasts along the Baltic Sea have many nuclear facilities, most operating, some awaiting decommissioning and more being planned. In the period 1970 to 2000, Swedish reactors were responsible for the worst releases to populations around the Baltic Sea, according to investigations by European communities and experts from the Riso Nuclear Research Laboratory. The northern Bottnian Sea and eastern parts of the Finnish Gulf are the most severely affected areas. Yet Finland plans to increase releases and like Sweden plans to store spent nuclear fuel, the most dangerous waste, in the sea and below the Baltic Sea. Authorities believe the vastness of the sea will dilute and spread the radioactivity, although clearly there are problems with nuclear contamination of the sea. In the summer of 2005 in Sweden, a storage area for low and intermediate radioactive waste on a tiny island in the sea at Forsmark (SFR), started to leak 10 times more cesium than normal into the Baltic Sea. The storage was not supposed to leak for at least 50 to 100 years but with water erosion the containers leaked after just 10 years. What will happen to the much more dangerous storage of highly radioactive spent fuel planned for the Finnish west coast and on the east coast of Sweden, is a good question the report asks.

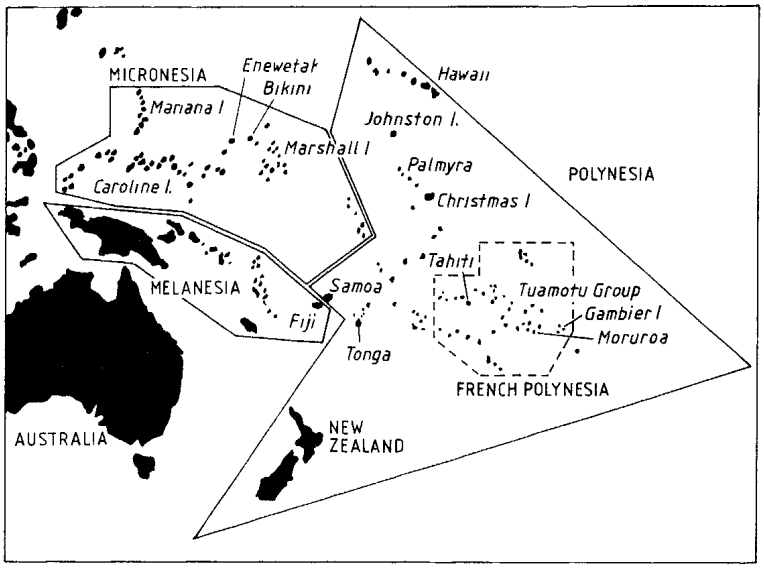
Fish spread radioactivity

Eating fish is the main way people absorb radioactivity, contributing 94% according to the Riso Laboratory report, Modelling & Assessment of doses.[17] The Helsinki Commission and the Swedish Radiological Protection Authority's statistics show increased levels of cesium-137 in fish caught outside four reactors at Oskarshamn, Forsmark, Studsvik and Olkiluoto. It's known that cesium and strontium are present in all the northern Bottnian Sea and in the Finnish Gulf, the most polluted parts of the Baltic Sea. Understandably, the Swedish Environmental Movement's report recommends thorough tracking of radionuclides in water, fish and sediments and tracking sources.

Moruroa's lasting legacy

Moruroa and Fangataufa atolls and the people of French Polynesia in the South Pacific endured a 30-years nuclear assault by France from 1966–96. Atmospheric testing ended in 1974 after rising concern about the tests. From 1975–96 France continued nuclear testing underground at Moruroa and neighbouring Fangataufa Atoll, with 137 deep underground tests, and 10 underground "safety trials." Shafts were drilled deep into the volcanic rocks under the atolls where nuclear devices were detonated. It was thought this would be safer. The possibility of radioactive leakage from the atolls was rejected in a French government report in the mid-1980s because of the depths at which the explosions occurred and because: "*radioactive particles are either trapped in the vitrified lava resulting from the explosions or absorbed by the rubble in the chimney.*"[18,19]

From the 1980s sharp increases in brain tumours, leukemia and thyroid cancer occurred in French Polynesia. It can take 15 to 20 years for cancer to develop. The French government kept cancer statistics secret and refused to allow independent health studies by impartial scientists, as Bengt Danielsson reported in a 1990 issue of the *Bulletin of Atomic Scientists*.[20] In 1983 France distracted attention from health matters by inviting four scientists to Moruroa for five days, an environmental scientist from Australia, two radiation experts from New Zealand and a marine biologist from Papua New Guinea. The group, lead by radiologist Dr Atkinson, had strictly limited access so nothing was learnt about leakage at the depths the underground bombs were being exploded. In the report of their findings[21] published in July 1984, Dr Atkinson was critical about possibilities of leakage, breakage and venting. "*As the mission was not permitted to sample sediments from the lagoon nor take samples from the safety trial area this avenue of verification was denied,*" he said.



Fourteen years later in 1998, after France invited the IAEA to assess Moruroa, the IAEA published a 2000-page report.[22–24] Key findings were:

- 5 kilograms of plutonium remained in the lagoon sediments of each test atoll
- Tritium concentration in the lagoon waters were 10 times higher than in the open ocean
- Particles of plutonium and americium persist on the atolls' land
- High levels of cesium 137 were found at certain sites
- An estimated 500 kilograms of plutonium, along with other fission products, are sealed in cavities under the atolls created by the explosions
- at least two shafts drilled for underground tests were also used to deposit plutonium waste.

Despite the very high levels of dangerous contaminants found on the atolls, the IAEA came to two implausible conclusions: no remedial action was justified on radiological grounds, and no need existed for monitoring the atolls for radiological protection. The conclusions are probably related to the fact that much of the information used in the report was provided by the French government itself which denied the potential for leakage.[18]

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The IAEA report met with widespread scepticism.[23–25] It failed to allay concerns because it did not carefully study the complex geology of the atolls including the porous, damaged basalt base. Breaches in the atolls outer walls would allow contamination of the marine environment by radioactive nuclides known to exist in the cavities. Small amounts of tritium in the lagoon suggested pathways exist for radioactivity to leach into the ocean. Although the exposure to radioactive fall-out of inhabitants on neighbouring atolls was noted in the report, no plans for further assessment were made. The IAEA's mandate as an advocate of nuclear power meant it was not an impartial investigatory body. No detailed survey of cancer rates throughout French Polynesia was made.

Is Moruroa safe?

Stimulated by the IAEA report and its identified high numbers of radionuclides in the atolls, Australian scientists, Douglas R. Hazell and Matthew H. England published in 2003 their investigation into the potential for radioactive releases from Moruro and Fangataufa atolls.[26] The atolls were used to test nuclear weapons underground for 21 years, ending in 1996. Moruroa, the larger atoll, was where most tests occurred. The South Pacific tropical Ocean is exposed to risks of the radioactive materials within the structure of the atolls and in the lagoons leaking into the marine environment.

Radioactive releases from Moruroa, the study reports, could occur through venting or upwelling from the atolls into the lagoon, or a major catastrophe, like an earthquake, or a rock slide in the upper level of the atoll. Releases could also come from the volcanic formations where the weapons tests were conducted at depths of 360–510 metres. Using a high resolution ocean circulation model, the Australian study is the first Moruroa study to include the El Nino/Southern Oscillation (ENSO) factor in its parameters. They found that even ten years after a catastrophic event like an earthquake releasing large quantities of radionuclides from Moruroa, contamination of the local marine environment would be 10,000 times greater than current natural radiation levels. Such a catastrophic event would be worse for nations in French Polynesia during an ENSO year, with the pollution staying in the region, as weak local currents would have limited effects in dispersing the pollution.

Within seven years of such a release from Moruroa, radioactive contamination could reach the east coast of Australia diluted by a factor of only 1000 of initial concentrations. Far higher levels of radionuclides would appear in the South Pacific than was predicted in earlier studies. Large quantities of radionuclides from Moruroa Atoll released into the South Pacific marine environment could have large-scale, long-term consequences, with high levels of radioactivity reaching other Pacific Island, South American and Australasian nations within ten years of the initial release.

What might such a toxic change in the marine environment over decades or hundreds of years mean for fish, turtles, dugong, sea birds and other marine creatures and for people fishing, as is their custom, and living in French Polynesia? The consequences for people in other Pacific Islands and Australia, New Zealand and South American countries from such an event when high levels of radioactive pollution would reach our countries are also very serious. Follow-up studies on the Australian Moruroa research are urgently needed. Adding extra impetus to the urgency, *Les Nouvelles de Tahiti* reported on 27/1/2011 that the Ministry of Defence, in a complete change of story, now recognises that collapse of the atoll is imminent.[27] Between "several dozen million

cubic metres" or "hundreds of million cubic metres" of Mororua atoll could fall into the sea at any time.

Independent, ongoing studies are essential, with unrestricted access to all data and to the atolls for sampling and monitoring of Moruroa and Fangataufa, the atmosphere, ocean, marine life and terrestrial environments. It is grossly irresponsible that France in the name of national security has for 40 years obstructed proper research on the consequences of its 30 years testing of nuclear weapons of mass destruction on vulnerable, low-lying atolls far from its own shores, when severe consequences for many countries and millions of people over a huge area are quite possible. It was deceptive to deny Moruroa would not collapse after a lengthy battering of 30 years or that no leakage or leaching will occur. Over 510 kilograms of plutonium in cavities in the ocean under the atolls is an enormous amount of one of the most deadly, long-lived compounds known to exist, with the potential, along with other dangerous radionuclides to severely affect marine life.

France, which cherishes ideas of liberty, equality, and fraternity could redeem itself by taking on the responsibility for funding fully independent studies, as minimal compensation for obstructing proper research for 40 years, for the damage inflicted on the region and its people, and the uncertain future which lies ahead. Research is also needed on the effects of global warming, ocean acidification and sea-level rise on the atolls. According to marine geologist Lionel Carter of Victoria University, Wellington:

> *Stronger weather systems that will accompany a warmer world will pressure the atolls through strong wave action, with the potential to dislodge weak reef material in water depths down to ~120m depending on the wave size. If the reef structure has been weakened by testing shocks then wave induced erosion may be enhanced. … Sea-level rise could conceivably redistribute sediment from the lagoon into the open ocean.*

Other persistent pollutants

Many other forms of toxic pollution are contaminating the oceans. Fossil fuel fertiliser runoff from intensive farms to the sea depletes oxygen and causes coastal hypoxia, leading to habitat degradation and sometimes extensive fish and invertebrate deaths, reports Scott C Doney, in a 2010 *Science* paper.[28] Low oxygen levels in the sea lead to "dead-zones" where many marine creatures are absent. There are now over 400 coastal hypoxic areas worldwide covering a large area. Planning needs to stop further coastal urbanisation and population growth causing more coastal hypoxia. Man-made nitrogen found in coastal waters downwind of industrial and intensive agricultural regions is linked with increased frequency of harmful algal blooms.

High levels of persistent organic pollutants, POPs, in the oceans and methyl mercury, a highly toxic organic form are serious concerns for marine ecosystem health and for human health if contaminated seafood is consumed. POPs bioaccumulate in the fatty tissues of marine organisms at far higher levels than in seawater and the pollutants are passed up the food chain[28] concentrating in higher marine organisms, including predatory fish, marine mammals, and seabirds and of course human beings.

PCB concentrations in wild algae are high enough now that experts believe they must be affecting the wider marine life

Compounding ocean problems, plastic debris from a huge range of consumer products, including packaging accumulate POPs. With increasing amounts of plastic debris in the oceans, marine organisms mistake more plastic for their natural food, so POPs get carried along the food web. Forty-four percent of seabird species ingest floating plastic while feeding on or near the surface of the oceans, according to research by Lorena Rios and others.[29]

Tim Flannery in his recently published book, *Here on Earth*, recounts how agricultural spraying began after the Second World War when American industry got access to large stockpiles of Germany's chemical weapons. American industry found "with a little tweaking," even very deadly chemicals could be usefully employed to exterminate pests which consumed crops.[30] It was seen as a big commercial opportunity, the vision being to transform the world into a fertile pest-free, weed-free paradise. What happened of course was very different with unintended mass extermination of other species including millions of human beings. POP chemicals, mainly organochlorines and organophosphates, were developed from chemical warfare agents. Flannery refers to them as Gaia killers, spreading through ecosystems, destabilising and poisoning entire food chains, including killing fish in streams.

Other dangerous toxic compounds, the polychlorinated biphenyls, PCBs, were used from the 1940s, in the electronics industry, in coolants, lubricants and pesticides. They are virulent carcinogens and their capacity to evaporate and be transported through the atmosphere makes them ace Gaia killers. Within a year of their manufacture one quarter would enter the oceans, a US Academy of Science study found. It was later discovered that just one part per billion depresses reproduction of marine algae and other marine plants by half. PCB concentrations in wild algae are high

enough now that experts, like Tony Koslow believe they must be affecting the wider marine life.[31]

Evidence shows serious impacts occurring even in far off oceans with polar bears and whales suffering similar birth defects as do humans exposed to PCBs. The most potentially devastating impact of PCBs, Flannery says, is probably happening in the depths of the oceans. As PCBs concentrate in algae they become even more concentrated in krill with their faeces contamination levels sometimes being 1.5 million times higher than in the surrounding seawater. Krill faeces sink speedily to the ocean floor where the toxic chemicals will be available to pollute marine life for thousands of years.[32] It is also in krill that the highest levels of radioactivity ever recorded were found with polonium-210 concentrations a million times higher than in the surrounding seawater. Marine biologists warn that the ocean depths "may be the first global biotic environment to face long-term danger from contamination."[32] Flannery gives an example of how recognition of the discovery of potentially catastrophic damage to the ozone layer, caused by chlorofluorocarbons, CFCs, brought about a rapid ban on CFCs. This was a lucky discovery.

But with limited knowledge of what's happening in the ocean depths with high contamination levels from various industrial chemicals, not enough is known about what's happening for scientists to warn of possible serious threats. Scott Doney in 2010 reported the marine environment is "woefully under-sampled for most compounds." A deeper understanding of human impacts on ocean biogeochemistry is essential for the scientific community to explore possibly synergistic effects among the many stressors in the oceans and the consequences of these for marine life and human societies.[28]

The buildup of life-threatening toxins from human activities in the oceans continues daily. It will be difficult to know when we have finally delivered the lethal dose to ocean life. With dead or dying oceans, how will we live? Dr Rosalie Bertell's recommendations are as valid now as in 1984. We need:

- an immediate end to all polluting activity, both military and commercial.
- A permanent effective ban on dumping radioactive waste and other dangerous persistent organic pollutants into the oceans.
- A network of internationally sponsored, independent radiation laboratories to test marine life particularly the ocean depths on a routine basis.
- an international network of marine biologists to monitor the oceans and ocean depths for persistent organic pollutants.

Above all, only by finding a life-sustaining way of living and turning away from the culture of the war on nature which industrial consumer societies have waged since the Second World War, can we hope to save the magnificent ocean paradise and its wonderful life.

Kay Weir is the editor of *Pacific Ecologist* which is produced in Wellington, New Zealand by the Pacific Institute of Resource Management. Contact pirmeditor@paradise.net.nz or see www.pacificecologist.org.

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