IONIZING RADIATION from NUCLEAR POWER and WEAPONS and its IMPACTS ON ANIMALS

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BACKGROUND

Uranium in the ground is generally not very concentrated and not very interactive with the biosphere. But once it is mined, milled (ground up), converted to a gas which is then "enriched" (concentrated in Uranium-235 from which Uranium-234, 238, etc. referred to as Depleted Uranium are removed) it gets out into circulation in the biosphere of living things. The enriched uranium is then fabricated into fuel that goes into either nuclear power or weapons reactors. In the reactor core the fuel is bombarded with neutrons. The uranium either splits giving off its binding energy to heat water, make electricity and form other radioactive elements or the uranium absorbs the neutron, gives off electrons, and forms plutonium which can be used to make nuclear weapons. The fuel is millions of times more radioactive when it comes out of the reactor than when it goes in. Some of the materials formed will be radioactive for literally millions of years.

At every link of this fuel chain, and in the transport from step to step, nuclear wastes are created and radioactive emissions are released into the air, water and environment, inevitably adding to the natural background radiation and increasing exposures to living things in that environment. Animals in the vicinity of nuclear facilities unavoidably take up some radioactivity through natural water and nutrient cycles.

The continuous creation and release of radioactive materials into the air, water, environment, food webs, organisms and gene pools of our planet are a giant experiment by the nuclear power and weapons industry. It is an experiment with neither a control group nor a sincere desire to learn about the biological and ecological consequences of radiation exposures on creatures and their environments. The result of these continuous releases is what has been called "a thickening of the radiation environment. Ionizing radiation effects are multiple, additive, cumulative and synergistic." [i] They impact this and future generations, but no major efforts have been carried out to assess these effects. As Dr. John Gofman stated, "you won't observe health effects if you don't look for them." In fact, government regulations that permit radiation exposure to humans only consider fatal cancer and birth defects in the first two generations, even though radiation is known to cause many other diseases and ailments and to affect generations well beyond the first two.[ii]

Over the years, allowable radiation exposure levels for nuclear workers and members of the human population have been set by the nuclear-promoting government agencies based on the amounts of radioactivity the nuclear weapons and power industry generates and releases.[iii] Although the National Environmental Policy Act requires some assessment of the flora and fauna impacted by nuclear facilities, there are no rules or laws preventing or limiting radiation exposure to animals (other than in their capacity as food for humans).

As the over 100 nuclear power reactors and the dozens of weapons facilities in the US age they get more and more contaminated, releasing greater amounts of long-lasting, biologically active

radioactive materials to the biosphere, increasing the routine radiation doses to workers, the public and the environment. In addition, the components become brittle and crack under years of radiation, pressure, heat and other stresses, raising the chances of accidents and large radiation releases. When they are dismantled, they are left on site, sent to waste sites that are legally allowed to leak, or most unbelievable—released as if not radioactive into the general recycling stream to make everyday household items. In order to accommodate the nuclear industry, the "legal" standards and methods of enforcement keep changing. The changes have not been made in order to improve protection of humans or other creatures. In the past 18 years, the radiation standards have shifted to allow *more* radioactivity to be regularly released into air, water and sewage, using clever redefinitions of doses and shifting to "risk based" rather than proscriptive regulations.

The nuclear establishment has been experimenting on living organisms since its inception.[iv] The most inhumane experimentation has been performed directly and deliberately on both human and nonhuman animals without their knowledge or consent. Some of this government-sponsored secret research was done to expand and technically "justify" use of radioactive materials, routine radiation releases to the environment and exposures to living things. Radiation experimentation on animals has been and continues to be commonplace. Much greater effort is directed toward exposure of animals in radiation experiments than to protecting them and their habitats from radioactive contamination in the natural environment. Minimal analysis appears to have been done on the impacts on individual animals and species of contaminating their living systems with ionizing radiation.

WHAT IS RADIATION?

Radiation is energy that travels in waves. *Ionizing* radiation can break molecular bonds, causing unpredictable chemical reactions. Humans and other animals cannot see, feel, taste, smell or hear ionizing radiation. Unavoidable exposure to ionizing radiation comes from cosmic rays and some natural material. Exposure to natural radiation is responsible for a certain number of mutations and cancers. Additional exposure above natural background radiation may result in otherwise preventable disease.

WHERE DOES IONIZING RADIATION COME FROM?

Ionizing radiation is matter or energy that is given off by the nucleus of an unstable atom in the process of decaying and reaching a stable (ground) state. This energy is released in the form of subatomic particles (alpha and beta) or waves (gamma and x rays). Most elements and their atoms are not radioactive. A few radioactive elements, like uranium, radium, and thorium, occur in nature. Nuclear power, bomb production and testing, have created and released *man-made* radioactive elements and forms of elements—radionuclides, that previously did not exist in the environment. Through mining and splitting of the atom in reactors, radionuclides have been released to flow through the natural systems on which life depends.

WHY DISPERSING RADIOACTIVE MATERIALS IS HARMFUL

Radiation affects all living things- genetic material, cells, individual animals and plants, biological systems and the general environment. When radiation hits a tissue or cell, it can kill the cell or damage it. If damaged, the cell can repair correctly; it can repair incorrectly but not reproduce; or it can repair incorrectly and reproduce. If a damaged cell reproduces it passes on the defects to future generations of cells. Furthermore, radiation can reduce immunity, making the animal more

susceptible to other diseases that would have been fended off. Radiation can cause mutations. Relatively recent research indicates that radiation behaves in unexpected ways. For example, Dr. Eric Wright has shown an unusual phenomenon called the Bystander Effect. When an alpha particle (positively charged radioactive particle) hits one cell, the effect is seen in another cell. This can also happen inter-generationally.

Radioactive contamination of the environment and organisms in it is actually a double whammy. Weakening the gene pool reduces the ability of organisms to prevent or overcome environmental threats while and at the same time increasing the environmental stresses to which the organisms will be exposed. This is especially disturbing when we realize that all future generations of species are in the genetic material of this generation of organisms.

BIOACCUMULATION

With increased uses of radioactive material, more radionuclides have been and continue to be released to the environment. Once released, they can circulate through the biosphere, ending up in drinking water, vegetables, grass, meat, etc. The higher an animal eats on the food chain, the higher the concentration of radionuclides. This is bioaccumulation. The process of bioaccumulating radionuclides can be especially harmful to animals at the top of the food chain because the concentrations of radionuclides are much higher. Radionuclides can concentrate in various kinds of tissue. For example, strontium 90, which mimics calcium, concentrates in bones causing bone cancer or leukemia. Cobalt mimics vitamin B-6 thus concentrates in the same places in the body that B-6 would go.

Industrial- generated radioactivity is moving into and through ecosystems including the bodies and genetic material of creatures that inhabit those ecosystems. Individual animals exist as a part of communities and in reliance on their natural habitats. When the food they eat, water they drink or live in and air they breathe provide not only nutrients but also poisons or carcinogens, their lives and the survivability of their species are stressed and threatened.

Some radiation effects are not immediately visible thus cannot be observed or quantified as indicators of damage. Examples are cancer with a latency period that makes it difficult or impossible to attribute the cause. In addition, the mechanisms that cause cancer are multiple and interdependent. Radiation exposure to an organism that has already been exposed and stressed could be the final straw to result in a cancer. If an organism has greater immunity or less other factors present that cause cancer it might not get cancer at that point.

Radiation is a carcinogen for nearly every type of human cancer. It can be expected to have similar effects on other animals.

EXAMPLES OF ANIMALS EXPOSED to IONIZING RADIATION from the NUCLEAR INDUSTRY

Animals in the vicinity of nuclear facilities and downwind from accidental radiation releases have been found to be radioactive. Examples include:

prairie dogs at the Hanford nuclear weapons reservation in eastern Washington;

frogs at the Oak Ridge nuclear weapons site in Tennessee;

mussels and lobsters near the Pilgrim atomic power reactor in Plymouth, Massachusetts;

reindeer in Lapland that ate radioactive moss that took up radiation from the Chernobyl nuclear power meltdown (The reindeer were originally declared off limits to people who have relied on them for survival for all known previous generations, but then allowable contamination limits were raised.); and

pigeons at the Sellafield, England nuclear reprocessing plant, among many others.

Efforts were made to prevent migratory birds from landing in their traditional location near the Oak Ridge, Tennessee nuclear weapons complex when it was determined that the lake was too contaminated. Birds that landed there and stayed for too long were shot to prevent spreading of radiation.

In 1987 the Point Reyes Bird Observatory "published a paper suggesting a link between the Chernobyl nuclear accident and song birds' productivity based on mist-netting data from the Palomarin Field Station. "[v]

Strontium found in children's teeth and bones led to a halt to above ground nuclear weapons testing in the United States during the Kennedy Administration.

After the meltdown at Three Mile Island in Pennsylvania (1979), the local veterinarian observed cows and other large mammals failing to give birth at the end of their pregnancies. Deformed plants and animals were observed including the birth of a two-headed calf.

Emergency preparedness for nuclear accidents such as Three Mile Island and Chernobyl is not adequate for people let alone animals. The US Federal Emergency Management Agency has sheltering guidelines for leaving animals and doing as best as can be done to avoid contaminated air, water and feed during a contamination incident.

"REGULATORY" AGENCIES

As with many other polluting industries, regulations allowing nuclear contamination were developed to protect the industry and give the impression of public protection, not to actually protect the public. There never has been even a pretense of protecting the animal or plant kingdoms or microorganisms.

The International Atomic Energy Agency has stated that in protecting humans from radiation, animals are adequately protected. But there is no discernable basis for this claim. In fact, humans are not adequately protected by radiation standards as many important factors are ignored. For example, the cells of children and developing fetuses are dividing much faster than those of the standard white male in his 20s on whom the "standard" is based. Those with reduced immunity and women are not adequately considered. Health effects other than fatal cancer and birth defects in the first two generations are not considered. No acknowledgement that multiple exposures act synergistically to give a much worse impact than additive exposures. Although committees have formed to look more closely at the impact of radiation on the animals, the goal seems more to dismiss the concerns than to truly protect the animals.

No US agency is charged with protecting species other than humans from industrial radiation. False claims of protection are made in some environmental assessments.

The threat now is at least twofold. First, the effects of radiation on animals in the environment are being ignored. Second, and perhaps more distressing, the promoters of nuclear activities are now beginning to allege that consideration has been taken for animals and that the doses to animals is acceptable. They (Department of Energy among others) are now beginning to claim that there are acceptable doses for animals that are stated in the same units as human exposures despite the difference in physiology. There is no solid evidence to justify these doses to animals.

There is a complicated structure of federal agencies in US with jurisdiction over nuclear materials. The Atomic Energy Act covers nuclear materials that are extracted from the ground and processed to generate nuclear power and to make nuclear weapons. The Nuclear Regulatory Commission licenses commercial nuclear activities and the Department of Energy promotes nuclear power and weapons and other nuclear technologies. NRC is charged with regulating commercial nuclear activities on site and the Environmental Protection Agency is charged with protecting the public health and safety outside of the site boundary. The Department of Energy self regulates nuclear activities within the nuclear weapons complex. The Environmental Protection Agency regulates the radioactivity once it leaves the sites. The EPA and EPA-"authorized" states regulate the hazardous materials from the nuclear fuel chain. (NRC sites are exempted from some hazardous waste laws due to powerful industry lobbying.)

No agency is charged with protecting the habitats of animals from man-made ionizing radiation. Actually even the human habitat is not protected per se. Radiation "protection" regulations developed more to protect the rights of the government and industries to use and release radiation than to protect the humans and other species or their habitats *from* ionizing radiation.

ACTION NEEDED:

There needs to be comprehensive oversight over the self appointed industry committees-both US and international-- that are in the early stages of setting "acceptable" contamination levels for animals and their habitats to prevent the unjustified legalization of harming wildlife with ionizing radiation.

Specifically with regard to the Endangered Species Act, there is a need for a call for Biological Assessments and Opinions of impacts from nuclear facilities of nuclear, chemical and thermal releases. The National Fish and Wildlife Service under Department of Interior and National Marine Fisheries Service under National Oceanographic and Aeronautical Association are the agencies with jurisdiction for these activities.

[i] Dr. Judith H. Johnsrud, nuclear geographer, Sierra Club Waste Committee, Radioactive Waste Subcommittee, at an Energy Club Budapest presentation to Hungarian Parliament, 2000.

[ii] 10 CFR 20 Nuclear Regulatory Commission Standards for Protection Against Radiation for workers and the public including radioactive releases into air, water and sewage.

[iii] Caufield, Catherine Multiple Exposures: *Chronicles of the Radiation Age*. The University of Chicago Press, 304 p., 16 halftones. 1989. In this book Caufield documents the first legal public exposures to radiation from nuclear bomb testing being set equal to the amounts of radiation being released quarterly by the Atomic Energy Commission from that very testing. She reports the individual medical exposure limits being set at whatever level caused skin reddening, the beginning of radiation burns.

[iv] Human Radiation Experiments Associated with the U.S. Department of Energy and Its Predecessors, U.S. Department of Energy, Assistant Secretary for Environment, Safety, and Health, Washington, D.C. 20585, July 1995 include such atrocities as injecting or administering plutonium, radium, radioiodine and other radionuclides to patients, prisoners, and healthy individuals including children for the purposes of research. http://tis.eh.doe.gov/ohre/roadmap/experiments/index.html

[v] Point Reyes Bird Observatory timeline.

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