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SeaWeb programs

DANGER AT SEA: Our Changing Ocean

SIGNS OF TROUBLE

C. POLLUTION AND CHEMICAL CONTAMINATION

1. Chemical contamination of fish, seabirds, and marine mammals:

According to the National Research Council (NRC) (63) there are, worldwide, more than 65,000 synthetic chemicals in use, approximately 10,000 of which have regular application. Many of these chemicals accumulate in the tissue of plants and animals that live in contaminated marine waters. An NRC report suggests that adequate information is available to determine risk assessment for only 2% of the chemicals entering the environment. Even less is known of the effects of the complex mixtures of contaminants that are now found within most living organisms (64).

However, many chemicals of human origin found in U.S. coastal waters are known to cause cancer or can disrupt the immune, endocrine and nervous systems in wildlife and humans (65, 66, 67). These effects can occur even when some pollutants, such as dioxins, are present in very low concentrations. Agricultural pesticides are among the most widely and commonly used chemicals; some 30 million pounds are applied to U. S. coastal watersheds annually (68).

Oil, though a naturally occuring substance, is also toxic to marine life. Operational oil discharge from ships, leaks from pipelines and storage tanks, and thousands of small oil spills yearly amount to several billion gallons of oil set free in the environment each year by human activities. Catastrophic oil spills continue to loom as an intermittent threat (69). Activities such as mining and various industrial processes also act to release or concentrate other natural toxic substances, notably heavy metals such as mercury and lead. Coastal waters and bottom sediments have become heavily contaminated in some areas, primarily around ports, industrial outfalls, and various ocean dump sites (70).

Contaminant-related liver cancer has been found in up to 20% of English sole in areas

of Puget Sound (71) and in 15% of winter flounder in areas of Boston Harbor (72). Pollutants have been considered the likely cause of a wide range of effects, including stunted or missing dorsal spines, scale disorientation and jaw deformities, in numerous fish species from Biscayne Bay in Florida and elsewhere (73). Studies on bottlenose dolphins in the Gulf of Mexico show evidence that some have compromised immune systems because of such chemicals as PCBs and DDT (74). Even within the vast area of the Pacific Ocean, contaminants have accumulated in upper level predators. For example, dioxins, furans, PCBs, and DDT are considered by scientists to be one important factor in the ongoing decline of the Midway Atoll black-footed albatross (34), a species that spends much of its life over vast expanses of ocean. Synthetic organic pollutants have even been found in deep sea fish off the Atlantic shelf (75).

2. Concentrations of pollutants in the sea-surface microlayer:

Contaminants concentrate in the sea surface microlayer (76, 77, 78), which is an important area for the early development of many fish and other marine species with planktonic life stages (79). Organic molecules concentrate at the water's surface, forming a film held together by the powerful surface tension at the water's uppermost boundary. Some of the many different substances that accumulate in the microlayer are natural and some originate from human-caused contamination of the air and water; but they concentrate in the surface film from anywhere between two to thousands of times more than in the water beneath or the air above (79).

Effects of contaminants on eggs and larvae found at the sea surface in sites along U.S. coasts include mortality, malformation and chromosome abnormalities in fish such as Atlantic mackerel and flounder (80). The hatching success of sole eggs from urbanized areas of Puget Sound was found in one study to be reduced by more than a half (76), while bass embryos collected from the microlayer offshore near Los Angeles had a high incidence of developmental abnormalities and chromosome aberrations (81).

3. Eutrophication:

Large areas of coastal waters have become virtual "dead zones", void of animal life because of the effects of eutrophication. Increased loads of nutrients are washed out from rivers and fall from the atmosphere to over-fertilize coastal waters. This happens primarily as a result of fertilizer runoff from agricultural fields, wastes from livestock operations, discharges from sewage treatment plants, automobile and power plant emissions, and seepage from septic tanks. Stimulated by this rapid influx, microalgae bloom in densities far exceeding the grazing potential of planktonic animals; when the excess algae die they are decomposed by bacteria. However, these bacteria have a very high oxygen demand, so as they multiply, oxygen in the water column and in

sediments is depleted. The result is large anoxic (no oxygen) or hypoxic (low-oxygen) areas where fish, invertebrates, seagrasses and other organisms cannot live.

"Dead zones" are not the only negative effect of nutrient pollution. Eutrophication includes many stages between nutrient input and the formation of oxygen-lacking zones. For instance, dense blooms of microalgae promoted by nutrients harm coastal environments by reducing the penetration of sunlight, which reduces desirable submerged vegetation such as seagrasses.

The phenomenon of eutrophication is on the increase worldwide (82). It is common in estuaries polluted by urban and agricultural runoff and has been well documented in the Gulf of Mexico, where the Mississippi flows out (83), and in the Atlantic off the northeast coast of the U.S. (84). The anoxic "dead zone" in the Gulf of Mexico lasts approximately eight months a year and can extend over several million acres (83).

Next Section: Difficulties in Addressing the Problem
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