Environmental Assessment and Risk Analysis Element

WHITE PAPER SUMMARY

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Environmental Endocrine Disruption and Its Potential Impacts on Public Health and the Environment in New Jersey

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Abstract

The purpose of this White Paper on endocrine disruption (ED) is threefold: 1. to provide a brief review of the current state of the science regarding the potential environmental health impacts of ED; 2. to consider how ED effects may be impacting environmental health in New Jersey now and in the future; and 3. to suggest practical approaches for investigating the existence and extent of such ED effects in New Jersey for the purpose of designing strategies to mitigate ED impacts.

BACKGROUND

Reports in the scientific literature have noted abnormal growth and development in various wildlife and human populations associated with the vast increase in the use of synthetic organic chemicals. These effects include: abnormal genitalia in alligators; gender changes in fish; poor reproductive outcomes in certain fish, birds, frogs, and humans; and abnormal sexual development in fish, mollusks, and avian species. The term endocrine disruption has been coined for such phenomena and applies most properly when the effect is related to the endocrine system. The scientific literature from the past several decades contains reports of persistent and bioaccumulative chemicals in the environment that may act via an endocrine mechanism to cause adverse health impacts in a number of species, including humans. It is critical to understand the impact of these compounds because they potentially have long-term adverse consequences, including adverse developmental effects.

SPECIFIC ENDOCRINE DISRUPTORS OF POTENTIAL ENVIRONMENTAL CONCERN

Many thousands of chemicals remain to be investigated for their potential endocrine disrupting properties. Among those currently recognized or suspected are:

- Nonylphenols - common breakdown products of detergents and anti-foaming agents.
- Bisphenol A - a common constituent of commercial plastics.
- Phthalates - PVC additives, that are now pervasive in the environment.
- PCBs (polychlorinated biphenyls).
- Polybrominated diphenyl ethers (PBDE) - a high volume flame retardant whose concentrations in the food chain and human milk are rising dramatically.
- DDT and its main metabolite DDE - still prevalent in the environment despite its ban in 1972.
- Pyrethroid pesticides - the most used indoor pest control agent.
- Atrazine - the most commonly applied herbicide in the U.S.
- Various pharmaceuticals, including synthetic estrogens in birth control pills and metabolites of synthetic estrogens discharged with sewage treatment effluent.

ANIMAL POPULATIONS IMPACTED BY ENDOCRINE DISRUPTORS

Frogs - Recent evidence suggests that concentrations of atrazine common in New Jersey surface waters can cause hermaphroditism in male frogs. Causes of gross frog deformities are still unresolved, but environmental contaminants may play a role.

Fish - Male fish in receiving waters of sewage treatment plants have been found with female characteristics including egg-containing testes. The discharge of female hormones, including birth control metabolites, appear to be involved.

Alligators - A 1980 spill of DDT and dicofol, organochlorine pesticides, in Florida's Lake Apopka resulted in a range of hormonally mediated effects, including altered reproductive tracts and abnormal genitalia in male alligators.

ENDOCRINE DISRUPTION EFFECTS IN HUMANS

While more speculative than effects in animals, potential effects of endocrine disrupting contaminants on humans are plausible and of considerable concern. These include:

Premature Female Breast Development (thelarche) - Puerto Rico has the highest reported rate of thelarche. A recent study found significantly elevated serum levels of several phthalates in thelarche cases with little or no elevation in those without thelarche. While not conclusive, the

ubiquity of phthalates in the environment raises concerns for interference with various secondary sexual processes in girls.

Sex Ratio - A decrease of about 0.4% in the proportion of males to female births has been noted in birth data since the 1950's in western Europe, and since the 1970's in the U.S. and Canada. The reasons for this are not clear. However, the dramatic drop in male births in Seveso, Italy following the well known dioxin release suggests a plausible connection of decreasing male births to environmental contaminants.

Male Fertility - Recent studies suggest a general decline in sperm density in men in developed countries since about 1940. In the U.S., the decline appears to be about 1.5% per year and about 3% per year in Europe. Although no clear cause has been suggested, the ability of several common contaminants (including nonylphenols and dioxins) to interfere with sperm production raises concerns for environmental exposure.

Breast Cancer - Several studies of varying quality have reported higher blood levels of DDE and PCBs in patients with breast cancer than in controls. Such a relationship, however, remains controversial.

THE ROLE OF THE FEDERAL GOVERNMENT IN ADDRESSING ENDOCRINE DISRUPTION

The Food Quality Protection Act and the Safe Drinking Water Act amendments of 1996 required the United States Environmental Protection Agency (EPA) to develop screening and testing strategies to determine whether certain substances may have hormonal effects in humans. In response, the EPA's Office of Prevention, Pesticides and Toxic Substances established an Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC). While the EDSTAC proposed framework has been finalized, much developmental, validation, and implementation work remains. The work is significantly behind the schedule set by the legislation, and systematic testing has not yet begun.

THE ROLE OF STATE GOVERNMENTS

States are in the best position to predict likely areas and populations at risk from endocrine disruption. They should also be able to identify those potential endocrine disruptor substances produced, used, and discharged in their jurisdictions with potential for local impact. Such substances may escape scrutiny at the national level. Existing state programs can be utilized to identify potential problem areas in the state. Cross-program efforts will be necessary to fully address the issue.

NEW JERSEY-SPECIFIC RECOMMENDATIONS

- General

The New Jersey Department of Environmental Protection (NJDEP) should convene a NJ Endocrine Working Group consisting of scientists from state government, academia, chemical and pharmaceutical companies, and environmental groups. Among the group's charges would be to review new scientific developments in the field and identify and prioritize surveillance and research topics for possible pursuit by NJDEP.

- Indicator development

Establish a New Jersey breast milk monitoring program to identify and track maternal and infant exposures to persistent endocrine disrupting chemicals. Such a program could identify specific chemicals, potential hot spots of exposure, and population groups with elevated exposures. This approach would also establish a baseline against which trends in exposures could be detected and tracked over time.

- Environmental surveillance

Institute surveillance that focuses both on the environmental occurrence of known and suspected endocrine disrupting chemicals and on the identification of effects in biota. Priorities for surveillance should include waterways impacted by current or historical industrial activity or high population density (e.g., Newark Bay); waterways that support both sewage treatment plant discharges and drinking water intakes in close proximity (e.g., the Passaic River basin); and waterways receiving significant runoff from cultivated land (i.e., golf courses and farmland). Likely chemical candidates for surveillance include pesticides (atrazine), personal care and cleaning products (nonylphenol polyethoxylates), pharmaceuticals and their metabolites (including synthetic estrogens), and flame retardants (PBDEs).

- Research

1. Support the development in NJ academic institutions of specific analytical capabilities for detection of low concentrations of endocrine disruptors in various environmental matrices. Such capability is essential for environmental surveillance.
2. Continue and expand studies of organochlorine effects on reproduction in endangered and sentinel NJ wildlife species including ospreys and eagles in the Delaware Bay region. Efforts should be made to identify other species and populations similarly affected.
3. Characterize the environmental chemistry and fate of known and potential endocrine disrupting chemicals and their metabolites in New Jersey. This should specifically include the chemistry relevant to the passage of such chemicals through wastewater treatment plants.
4. Characterize fish and other aquatic populations in heavily utilized waters, including receiving waters of sewage treatment plants. Such characterization should include gender shifts, sexual development, and reproductive competency.

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