

Ecotoxicology Program Florida Caribbean Science Center

The goal of the Ecotoxicology Program at the USGS Florida Caribbean Science Center is to identify sensitive toxic endpoints (biomarkers) and to evaluate the effects of environmental contaminants on vulnerable wildlife populations.



Significant evidence suggests that exposure to a variety of environmental contaminants can alter the normal biological functions of the endocrine, reproductive, and immune systems in wildlife. Although many of the observed effects are sublethal, problems such as impaired hormone production or activity; modified adult sexual behavior; and reduced fertility, hatchability of eggs, and survival of offspring can lead to substantial losses in wildlife populations.

High concentrations of nutrients and pesticides from agriculture, effluents from industries and sewage treatment facilities, and chemical contamination resulting from human use and misuse are all avenues for exposure to environmental contaminants.

One of the primary objectives of the Ecotoxicology Program is the development and application of techniques to monitor subtle physiological alterations, such as changes in hormone concentrations and gonadal development, that may result from exposure to endocrine-disrupting chemicals (EDCs). The following are among methods currently being used:

1) surveys to identify potential environmental contaminants and their effects on a variety of wildlife species, including

invertebrates, fish, reptiles, and mammals;

2) controlled field experiments to evaluate direct and multigenerational effects of EDCs;

3) investigations to document mechanisms of toxicity and their biological and ecological relevance; and

4) analytical procedures and expertise provided to other research and regulatory programs within USGS, DOI, and partner agencies.

Ongoing Research

Evaluation of Potential Reproductive Effects of Papermill Effluents on Largemouth Bass, Gambusia and Freshwater Mussels

Papermill facilities are major sources of aquatic contamination in the US. However, few studies have examined the potential for the complex chemical mixtures released by mills to affect exposed wildlife populations. A series of studies has focused on the potential adverse effects of these effluents on wildlife. Results have indicated altered endocrine function and decreased reproductive success for largemouth bass and gambusia

naturally exposed to papermill effluents, as well as exposed under controlled experimental conditions. Another study assessed the effects of papermill effluent on freshwater mussels to evaluate the potential of freshwater mussels to serve as indicators of environmental damage. Mussels exposed to ecologically relevant concentrations of papermill effluent had significantly reduced health status and reproductive dysfunction. These efforts have validated largemouth bass and freshwater mussels as models for measuring effects of papermill effluent on aquatic life. Future applications of this model will enable an assessment of industry process modifications and documentation of improvements created by mill upgrades at several sites in the southeastern United States.

Environmental Contaminants and Endocrine Disruption in Largemouth Bass

Four independent studies are determining the effects of environmental contaminants on fish populations. A repertoire of indicators, including sex steroid and vitellogenin concentrations, gonadal somatic index, gonadal histology, and egg production are routinely used to establish endocrine function and reproductive potential. To date, alterations in plasma sex steroid hormones have been reported for largemouth bass, carp, and catfish exposed to sewage

effluent; papermill effluent; pesticides; Atrazine, a commonly used water-soluble herbicide; and methyl mercury. Effects on reproductive success and endpoint significance has been a primary focus of these studies



Everglades, an aerial photograph

Assessment of Toxic Substances in the South Florida/Everglades Ecosystem: Wildlife Exposure and Effects Assessment

Few areas in the United States are as vulnerable to environmental contamination as South Florida's ecosystems. Available data indicate the presence of a wide array of contaminants, including pesticides, PCBs and PAHs, mercury, and nutrients. However, potential exposures and adverse effects on the fish, reptiles, invertebrates, amphibians, birds and mammals utilizing this critical ecosystem are not known.

The South Florida Ecosystem Restoration Task Force has initiated hydrologic restoration as a primary goal of ecosystem restoration and resource management. These efforts are designed to restore original habitat conditions to support viable wildlife populations while providing flood control and water resources. However, restoration planning has not considered or evaluated the resulting potential exposures to contaminants and the adverse effects of restoration activities on contaminant distributions and subsequent wildlife exposures. Several of our ongoing research efforts have linked water management efforts to altered contaminant distributions and resulting wildlife exposures. These efforts include examinations of exposures and effects in al-

ligators, wading birds, fish and invertebrates (freshwater mussels and apple snails) throughout the South Florida ecosystem. New studies will assess current wildlife contaminant exposures and effects and predict future restoration-driven exposures. These efforts will be critical components of any future assessments of risk, the goal of which will be prevention of adverse effects on wildlife within the South Florida ecosystems.



Freshwater mussels using biological lure to attract a host fish

The Effects of Contaminants in Fish on the Glochidial Success and Survival of Juvenile Freshwater Mussels

Of the 300 known species of freshwater mussels in North America, 70% (213 taxa) are considered endangered, threatened, or of special concern, and environmental contaminants have been implicated as one possible cause for their decline. This study is the first to examine the effects of several contaminants on the development of glochidia (parasitic mussel larvae that exist on the gills of the host fish) and survival of juvenile mussels. Glochidia received indirect exposure via their attachment to host fish, which had been implanted with time-release contaminant pellets. Results to date indicate that juvenile survival is decreased by exposure to DDE, toxaphene, and Atrazine, with sensitivities to contaminants depending on the species of mussel.



Juvenile alligator hatched in lab

Lake Apopka Revisited: An Evaluation of Environmental Contaminants and Reproductive Anomalies in Alligators

High concentrations of nutrients and pesticides from agricultural and sewage treatment facilities and a major chemical spill have made Lake Apopka one of the most polluted lakes in Florida. High levels of environmental contaminants are most likely the primary factor contributing to the decline of alligators on Lake Apopka and other lakes in Central Florida. Ongoing studies are examining effects mediated through the maternal system and the ability to induce these effects under experimental conditions using captive population of adult alligators. These efforts have indicated a complex mechanism of action for contaminants in adult alligators and multi-generational effects of complex mixtures of chemicals including pesticides, nutrients, metals, and biological toxins.

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