

Endocrine Disruptions


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April 7, 2009

Lecture Outline

- Introduction to Endocrine Disruptions
- Impact of Amphibian Populations/Individuals
- Case Studies
 - Acris Crepitans
 - Pesticide mixtures
- The global impact

Terms

- **Endocrine System** - a system of small organs that involves the release of extracellular signaling molecules called hormones; regulating metabolism, growth, development, puberty and tissue function.
- **Endocrine Disruptors** - exogenous substances that act as hormones in the endocrine system and disrupt the physiological function of endogenous hormones



Effects on Individuals

- Metabolic disruption
- Development/growth regulation
- Sexual development
- Tissue function
- Hormonal changes

Effects on populations

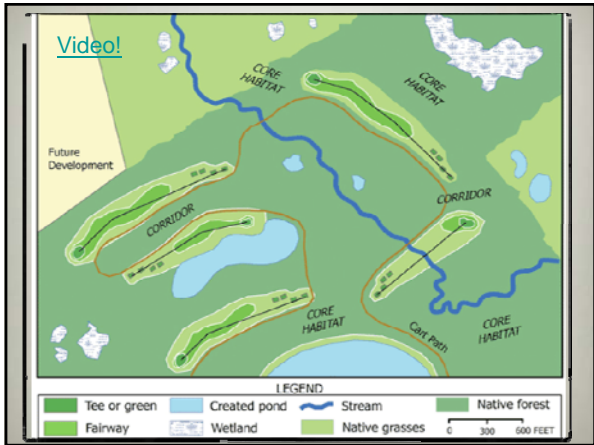
- Reduced recruitment
- Reduction of genetic diversity
- Reduced reproductive capabilities
- Increased predation on populations
- Genetic deformities
- Less studied?

A Few Causes of Endocrine Disruption


- Pollution (PS and NPS)
- Pesticide/Herbicide Use
- Global Warming (catalyst)
- Run-off from Roads
- Acid Rain
- Silvicultural Operations
- Diseases (catalyst)
- UV-B Radiation (catalyst)
- Forest Fragmentation
- Urban Expansion







ACRIS CREPITANS



- "Intersexuality and Cricket Frog Decline" - Amy Reeder, et al.
- Study gonads of 12,661 anurans from 1852 to 2001 in Illinois for intersexual characteristics
- Found that amphibian declines correlated with production of chemicals
- Found historical and geographic trends supporting endocrine disruption as main form of decline

ACRIS CREPITANS

- Eras studied and Results:
- Preorganochlorine era (1852 - 1929)
 - "Control era"
- Industrial growth/initial use of PCB's era (1930 - 1945)
 - Percentage of intersex anurans increased in correlation with industrial/chemical development
- Elevated industrial growth/chemical use era (1946 - 1959)
 - Percentage of intersex at its highest; heavy use and manufacturing of DDT, PCB.
- Environmental movement and regulation (1960 - 1979)
 - Intersex percentages started to decline; US banned DDT sales
- Era of continued regulation (1980 - 2001)
 - Continued decline as more chemicals are banned

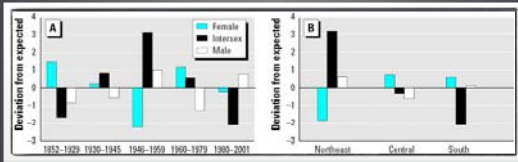
Source: Reeder, et al.

Table 1. Effects of synthetic chemicals on endocrine and cognitive function.

Compound	Estrogen/ androgen	thyroid	Glucocorticoid	Minors target	References
Industrial chemical					
Hexachlorobenzene	A-L1	?	?	?	7
Polychlorinated biphenyls	A-L1	Mixed, L1; endocrine-disrupting at 1000	Mixed, L1; endocrine-disrupting at 1000	?	7
PCBs	A-L1/A-	Mixed, L1; endocrine-disrupting at 1000	?	?	7
PCPs	L1	?	?	?	7
Polychlorinated biphenyls	A-L1	?	?	?	7
Polychlorinated biphenyls/biphenyls	A-L1	?	?	?	7
Polychlorinated biphenyls	L1	?	?	?	7
Agricultural chemical					
Organochlorine pesticides	A-L1	?	?	?	7
Aldrin	A-L1	?	?	?	7
Chlordane	A-	?	?	?	7
Dieldrin	A-	?	?	?	7
Endosulfan	A-L1	?	?	?	7
Heptachlor epoxide	A-L1	?	?	?	7
Permethrin	A-L1	?	?	?	7
Phosalone	A-L1	?	?	?	7
Triphenylethylene herbicides	A-L1	?	?	?	7
Azinphos methyl	A-L1	?	?	?	7
Carbofuran	A-L1	?	?	?	7
Carbofuran	A-L1	?	?	?	7
Endosulfan	A-L1	?	?	?	7
Endosulfan	A-L1	?	?	?	7
Endosulfan	A-L1	?	?	?	7
Endosulfan	A-L1	?	?	?	7
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Endosulfan	A-L1	?	?	?	7
Endosulfan	A-L1	?	?	?	7
Endosulfan	A-L1	?	?	?	7

acris crepitan

- Intersex individual concentrations:
 - Highest - industrialized/urbanized areas
 - Intermediate - intensively fertilized agricultural lands
 - Lowest - less intensively managed and more ecologically diverse areas
- Reduction in numbers from more urban/industrialized areas
- Geographic distribution of both intersex and declining populations are congruent
 - Areas with the highest endocrine disruption did not even produce enough specimens for sampling



Deviations of observed from expected values of cricket frog sex (A) by time period and (B) by region. Expected values were determined from the overall data set using the chi-square test.

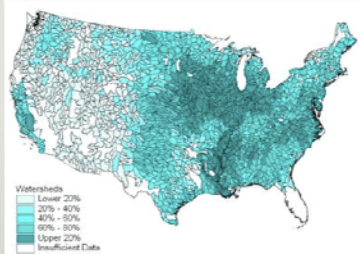
Source: Reeder, et al.

Pesticide Use

- "Pesticide mixtures, endocrine disruptions, and amphibian declines: Are we underestimating the impact" by Tyrone Hayes, et al.
- Studied 9 pesticides
 - 4 herbicides, 2 fungicides, and 3 insecticides
- Examined larval growth, development, sex differentiation, and immune function in relation to pesticide mixtures commonly found in riparian zones



Potential pesticide runoff from cropland

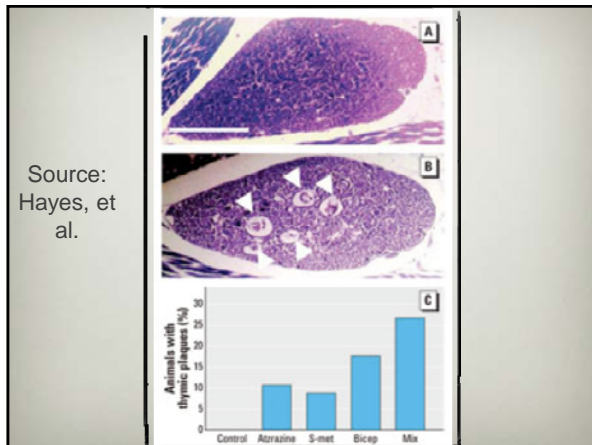


Note: The above values are based on the assumption that the entire amount of pesticide applied to cropland is lost to runoff. This is not necessarily true. Pesticide runoff is also affected by the amount of rain that falls on the area. Pesticide runoff is also affected by the amount of water that is used for irrigation. Pesticide runoff is also affected by the amount of water that is used for other purposes. Pesticide runoff is also affected by the amount of water that is used for other purposes.

Source: Economic Research Service - 2002. Pesticide data from USDA database.

Hayes, et al.

- Findings:
 - Retarded larval growth and development (exacerbated when pesticides were mixed)
 - Negated or reversed the typically positive correlation between metamorphosis and size (took longer to metamorphose and were smaller)
 - Also damages the thymus (results in reduced immunosuppression and susceptibility to diseases/pathogens)
 - Previous studies looking at only one pesticide may have grossly underestimated the effects of pesticide mixtures



The Global Impact

- As countries strive to become “developed” nations they produce more harmful chemicals that will eventually make it into the water
- Endocrine disruption unifies all the other theories of decline we’ve discussed, providing an all encompassing theory, that explains without a shadow of doubt, that this is the single greatest threat to amphibians

The Global Impact

- Why so important?
 - Endocrine disruption is the most serious threat to amphibians
 - "Hot beds" for amphibians are in less developed countries meaning that most likely conditions will only get worse
 - Globally, the amount of chemicals introduced into our water is rising
 - Endocrine disruption is exacerbated by other theories of decline

Works Cited