

Human Impacts on the Environment

Based on Mader, Sylvia S. 1996. *Biology* - 5th Ed. WCB

and

Cox, G.W. 1997. *Conservation Biology* - 2nd ed. WCB

and

Levine, J.S. and K.R. Miller. 1994. *Biology: Discovering Life*. D.C. Heath

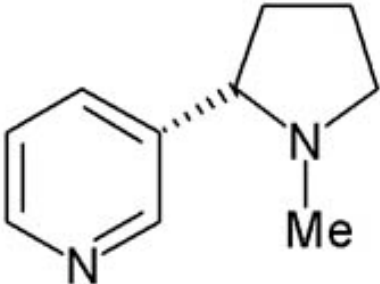
Biomagnification

Reading: Chapter 7 in Levine and Miller

Chapter 22 in Cox

Thesis: Human intervention has altered ecosystems, sometimes in unexpected ways (biomagnification)

Introduction: A Very Toxic Chemical

MSDS		Model
<p style="text-align: center;">Overview:</p> <p>XXXXX is an alkaloid contained in the leaves of many species of plants. A 95% solution of the free alkaloid in organic solvent has been marketed in the past as a greenhouse fumigant. Another product used for the same purpose is a 40% aqueous solution of XXXXX sulfate. Significant volatilization of XXXXX occurs from both products. Commercial XXXXX insecticides have long been known as Black Leaf 40. Formulations include sprays and dusts.</p>		
<p style="text-align: center;">Toxicology of XXXXX</p> <p>XXXXX alkaloid is efficiently absorbed by the gut, lung, and skin. The sulfate salt is absorbed by lung and gut, but is poorly absorbed across the skin. Extensive biotransformation occurs in the liver resulting in a residence half-life of two hours or less. Both the liver and kidney participate in the formation and excretion of multiple end-products, which are excreted within a few hours.</p> <p>Toxic action is complex, involving both stimulation and blockade of autonomic ganglia and skeletal muscle neuromuscular junctions, as well as direct effects on the central nervous system. Paralysis and vascular collapse are prominent features of acute poisoning, but death is usually due to respiratory paralysis, which may ensue promptly after the first symptoms of poisoning.</p>		

Manifestations of XXXXX Poisoning

Early symptoms of poisoning are salivation, nausea, vomiting, and diarrhea. Burning sensation in the mouth and throat and abdominal pain are reported. If dosage has been high, vascular collapse, dyspnea then respiratory failure, cyanosis, and unconsciousness may ensue promptly.

Agitation, sweating, headache, pupillary constriction, dizziness, incoordination, confusion, weakness, tremor, and convulsions occur early in less fulminant poisoning. Initial hypertension is probably due mainly to generalized vasoconstriction. Subsequent shock is caused by vasodilatation, often associated with vagotonic asystole or severe cardiac arrhythmias. Respiratory failure is caused mainly by paralysis of the muscles of respiration

Monitor cardiac status by electrocardiography, and measure blood pressure frequently. Cardiopulmonary resuscitation may sometimes be necessary.

Vascular collapse may require administration of norepinephrine and/or dopamine. Consult package inserts for dosages and routes of administration. Infusions of electrolyte solutions, plasma and/or blood may also be required to combat shock.

There is no specific antidote for XXXXX poisoning. Severe hypersecretion (especially salivation and diarrhea) may be controlled by intravenous atropine sulfate.

[MSDS](#)

I. Causes of Environmental Impacts:

Overview at this point, details later.

A. Human Population Growth

1. Exponential in nature
2. From 130 million to 5.4 billion in 2,000 years
3. May level off at 10-15 billion by 2050

B. Industrialization

1. Greater demands on ecosystems
2. Supports larger population
3. Concentrates toxic materials

C. Economic growth

1. 1 baby born in US has same economic impact as 200 born in undeveloped countries.

D. Agriculture

1. Necessary for human civilizations
2. Limited amount of arable land

II. Current Environmental Problems

- A. Water Pollution
 - 1. Industrial pollution
 - 2. Surface pollution
 - 3. Groundwater contamination
 - 4. Residential Sewage
- B. Air Pollution
 - 1. Smog
 - 2. Acid Rain
 - 3. Ozone Depletion
 - 4. Global Warming
- C. Loss of Diversity

III. Problems caused by large-scale Agriculture

- A. Loss of Diversity
- B. Fertilizers and Eutrophication
- C. Pesticides
- D. Irrigation
- E. Soil Erosion
- F. Energy Use

IV. Bioaccumulation & Biomagnification

- A. bioaccumulation: increase in concentration of a pollutant from the environment to the first organism in a food chain**
- B. Biomagnification: increase in concentration of a pollutant from one link in a food chain to another**
- C. pollutant must be:**
 - 1. long-lived**
 - 2. mobile**
 - 3. soluble in fats**
 - a) if soluble in water they will be excreted
 - 4. biologically active**

D. classic example: DDT

1. chlorinated hydrocarbon
2. exhibits qualities shown above
 - a) half life 10-15 years
3. low human toxicity
4. heavily sprayed to combat
 - a) mosquitoes in Burma
 - b) elm bark beetle
 - c) Japanese beetle
 - d) forest pests
5. noticeable kill of fish, birds, mammals with above sprayings
6. Rachel Carson - *Silent Spring* (1962)

E. case study: Long Island Estuary (Figure 22.1 in Cox)

1. water → zooplankton: 800x
2. zooplankton → fish #1: 31x
3. fish #1 → fish #2: 1.7x
4. fish #2 → gull: 4.8x
5. overall: 202,368x

F. sub-lethal effects:

1. shell-thinning in birds
 - a) bird eating raptors
 - b) fish-eating raptors
 - c) fish-eating water birds
 - d) carrion feeders
 - e) shells are too thin to brood
 - f) mechanisms not fully understood
 - g) many populations have recovered
 - (1) migratory birds may be exposed to pesticides in other countries
2. effects on sex ratios in some species of birds
 - a) males "feminized"

G. biomagnification also known for heavy metals and other substances

1. PCB's
2. PAH's
3. mercury, copper, cadmium, chromium, lead, nickel, zinc
4. cyanide (used in leaching gold)
5. TBT - tributyltin
6. selenium

H. modern pesticides

1. carbamates and organophosphates
2. more toxic
3. shorter-lived
4. resistance
5. important tools against disease
6. IPM

V. Other pollutants:

- A. plastics
- B. radioisotopes
 - 1. may be toxic and radioactive!
- C. oil

VI. Regulations:

- A. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
 - 1. 1947
 - 2. requires registration of pesticides for specific uses
- B. Federal Environmental Pesticide Act
 - 1. 1972
 - 2. controls use, release of pesticides
- C. London Dumping Convention
 - 1. 1972
 - 2. ratified by 64 countries
 - 3. bans deliberate discharge of various toxic or other wastes
- D. International Convention for the Prevention of Pollution from Ships (MARPOL)
 - 1. 1988
 - 2. prohibits dumping of plastics at sea
 - 3. ratified by 40 countries

See Also: [Environmental Laws](#)

VII. Predation

- A. predation occurs when one organism (predator) eats another (prey)
- B. adaptations for predation depend on type of prey
- C. *carnivores* eat meat
 - 1. fast, good eyes, teeth and claws
- D. *herbivores* eat plants
 - 1. chewing teeth, elaborate stomachs
- E. predation may control size of prey population
 - 1. number of prey also controls predator population
 - 2. lynx-hare example

F. defense - every organism is potential prey**1. thorns, shells or spines**

16112, 17178

2. teeth or claws

16214 16215

3. chemicals

poisonous (distasteful)	14869	15066	16065
squirted	15265		
poisonous (bite or sting)	15588	14914	16149
	14875	16211	

4. coloration

a) <i>warning coloration</i>	15230		
b) <i>concealment (cryptic coloration)</i>			
14421	14838	14839	14946
15178	15189	15200	15266
15640	15794	15895-15898	
16119	16615	17452	17453
15080	15216	14967	

5. startle movements

15882	18929	15202	15205	15230
15231				

6. vigilance

31373

7. speed

16807 16938

8. schooling

15838

G. coevolution

1. - as predators get better at catching prey, prey get better at escaping, predators must get better at catching ...

H. mimicry**1. Müllerian - both dangerous****2. Batesian - one distasteful, the other not**

15236	15247	15256-15259	14867	15066
18785-18786 (coral snake-king snake)				

VIII. Interactions between organisms:

TYPE OF INTERACTION	EFFECT OF INTERACTION ON:	
	SPECIES 1	SPECIES 2
COMPETITION	(-)	(-)
PREDATION	PREDATOR (+)	PREY (-)
PARASITISM	PARASITE (+)	HOST (-)
HERBIVORY	HERBIVORE (+)	PLANT (-)
DETRITIVORY	DETRITIVORE (+)	DETRITUS (0)
COMMENSALISM	(+)	(0)
MUTUALISM	(+)	(+)

Table 1. Types of species interactions

Cancer:

Cancer - a disease of the genes

IX. Causes:

- A. Carcinogens
- B. Radiation
- C. Viruses

X. What is cancer?

- A. Uncontrollable growth of cells
 1. Cells fail to respond to signals which prevent growth
 2. Cells act as if they are constantly being signalled to divide
 3. Cells fail to respond to signals to differentiate
- B. Tumors
 1. Benign - confined to well-defined growth
 - a) More easily treatable
 2. Malignant
 - a) Spread through body - metastasize
 - b) Difficult to treat

XI. Causes in detail:

A. Genetic changes responsible for cancer

1. Chemicals or radiation may cause mutation
2. Viruses may transfer genes
3. Defects may be inherited

B. Two types of genes:**1. Oncogenes - cause cancer by promoting growth**

- a) May have normal function altered by mutation
- b) May produce growth-stimulating chemicals
- c) May cause cell to act as if growth-stimulating factors are present
- d) May cause cell to ignore growth-regulators

2. Tumor suppressors

- a) May produce growth regulators
- b) Gene p53 prevents cells with damaged DNA from dividing
 - (1) If damaged, cancer may result
 - (2) If a faulty p53 gene is inherited, individual is more susceptible to cancer

XII. Treatment**A. Surgery, especially for benign tumors****B. Chemotherapy - targets rapidly dividing cells****C. Radiation therapy - for localized tumors**

1. Rapidly dividing cells more susceptible

D. Immunotherapy - taking advantage of differences in cancer cells