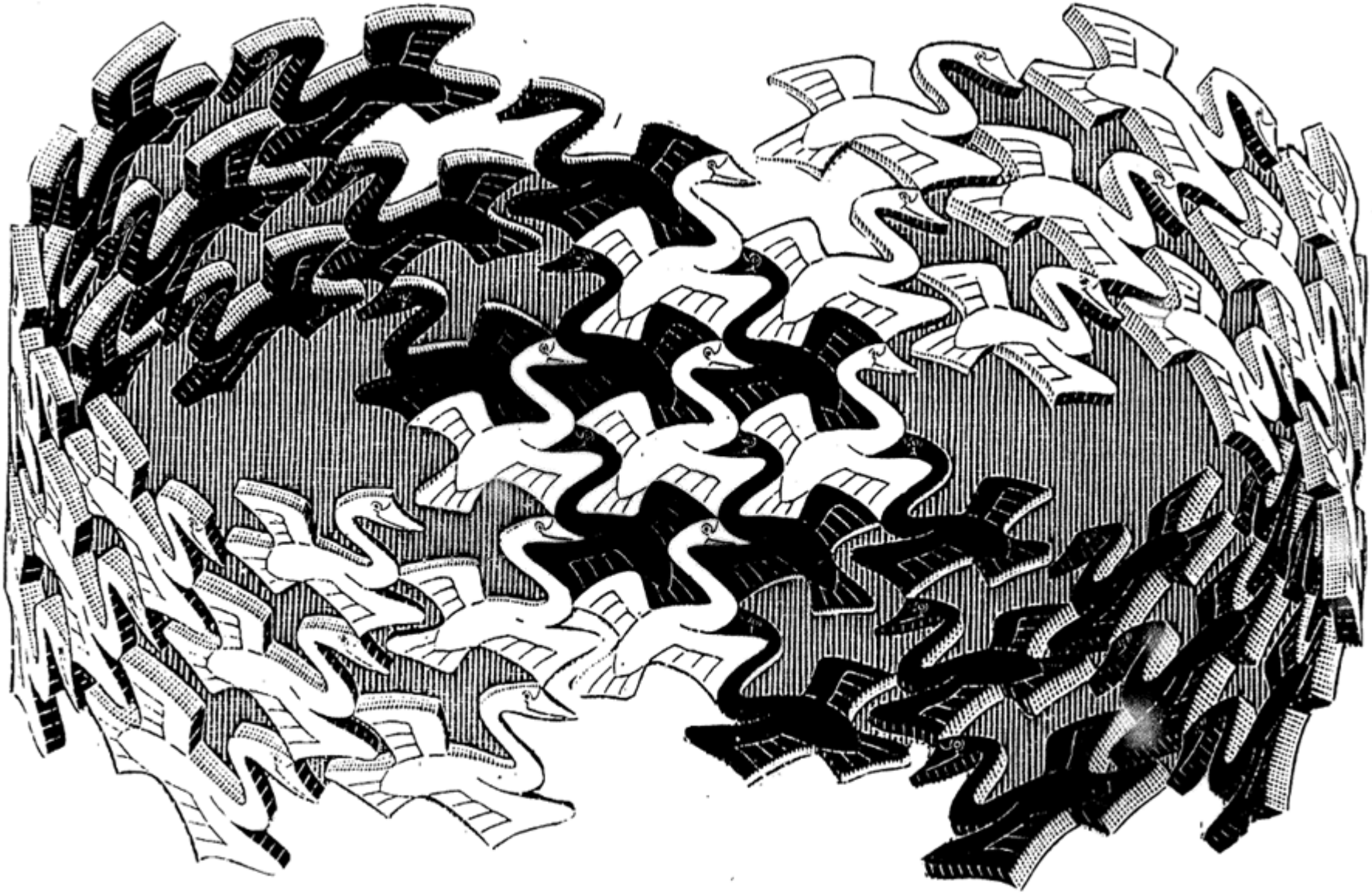


MC Escher

Ecosystems
-
a context for assessing pesticide effects on non-target organisms

Sverker Molander
Professor
Environmental Systems Analysis
Chalmers University of Technology
Sweden

Starting points

- I think we are here for…
- I think I'm here to…

Ecosystems

- Like a human society
  - Personalities
  - Families
  - Professions
  - Municipalities
  - Industries, branches
  - …

It is much about allocation of scarce resources

Ecosystems = energy dissipation

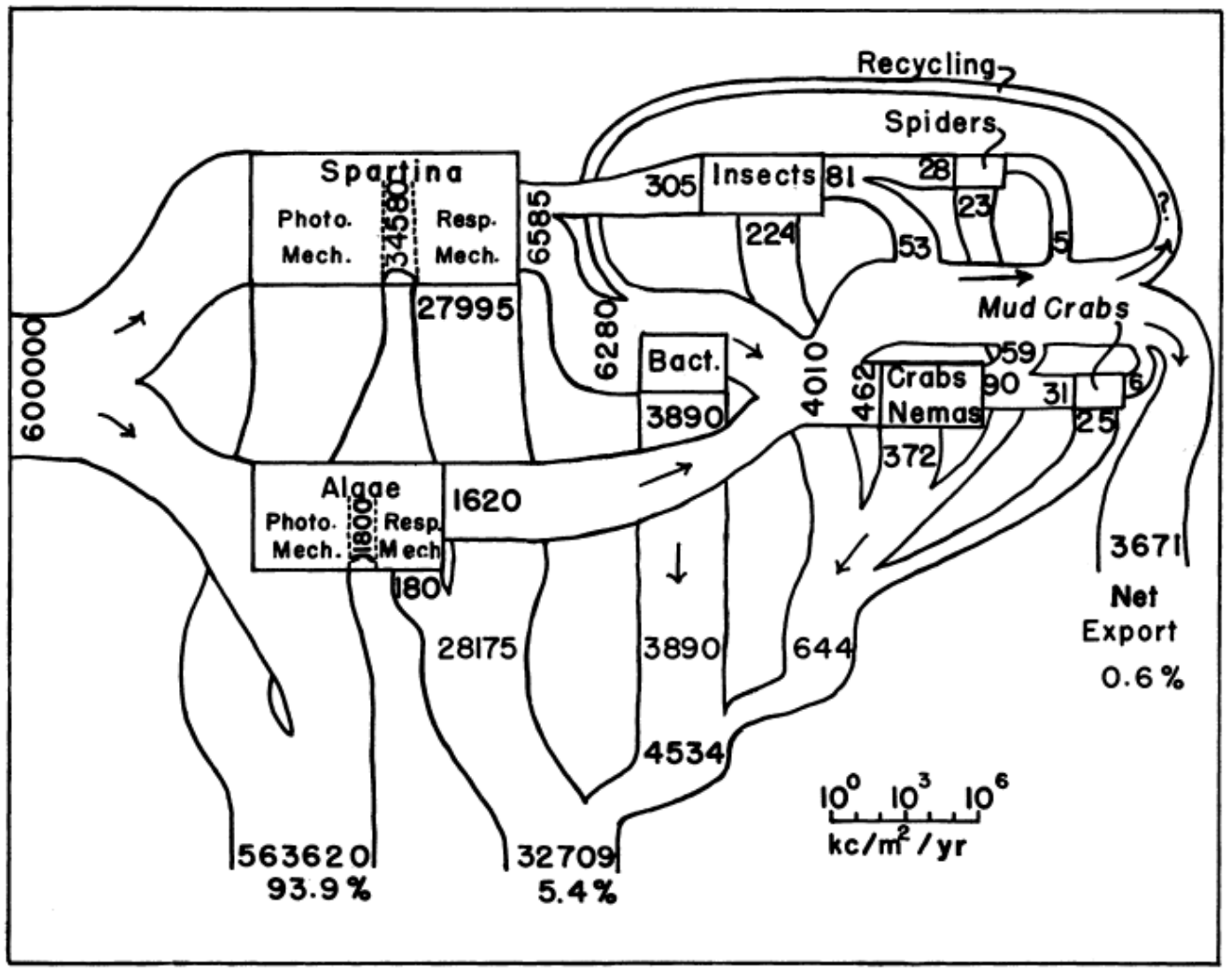
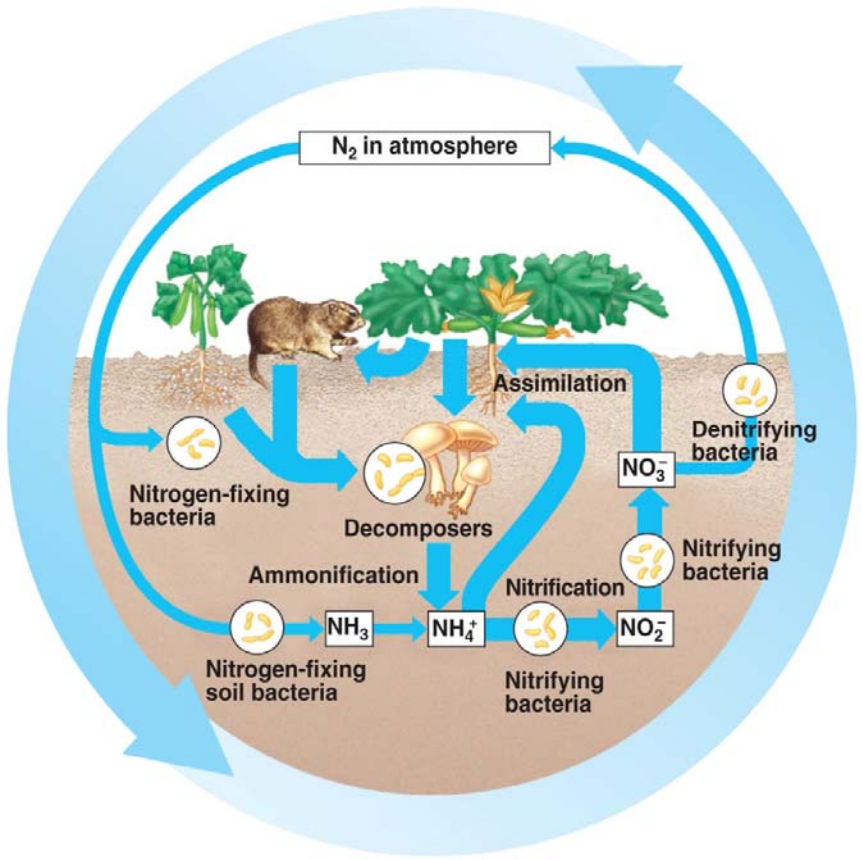


FIG. 4. Energy-flow diagram for a Georgia salt marsh.

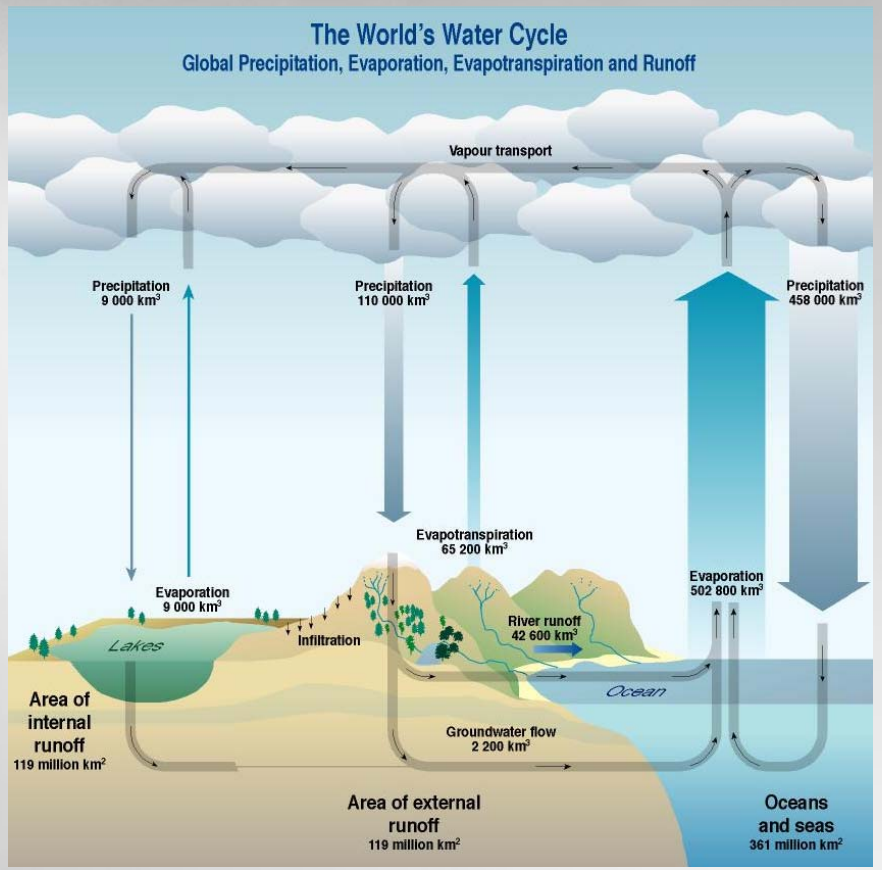
From J M Teal (1962) Ecology 43 614-624

Ecosystems = material flows

- Transformations and transports

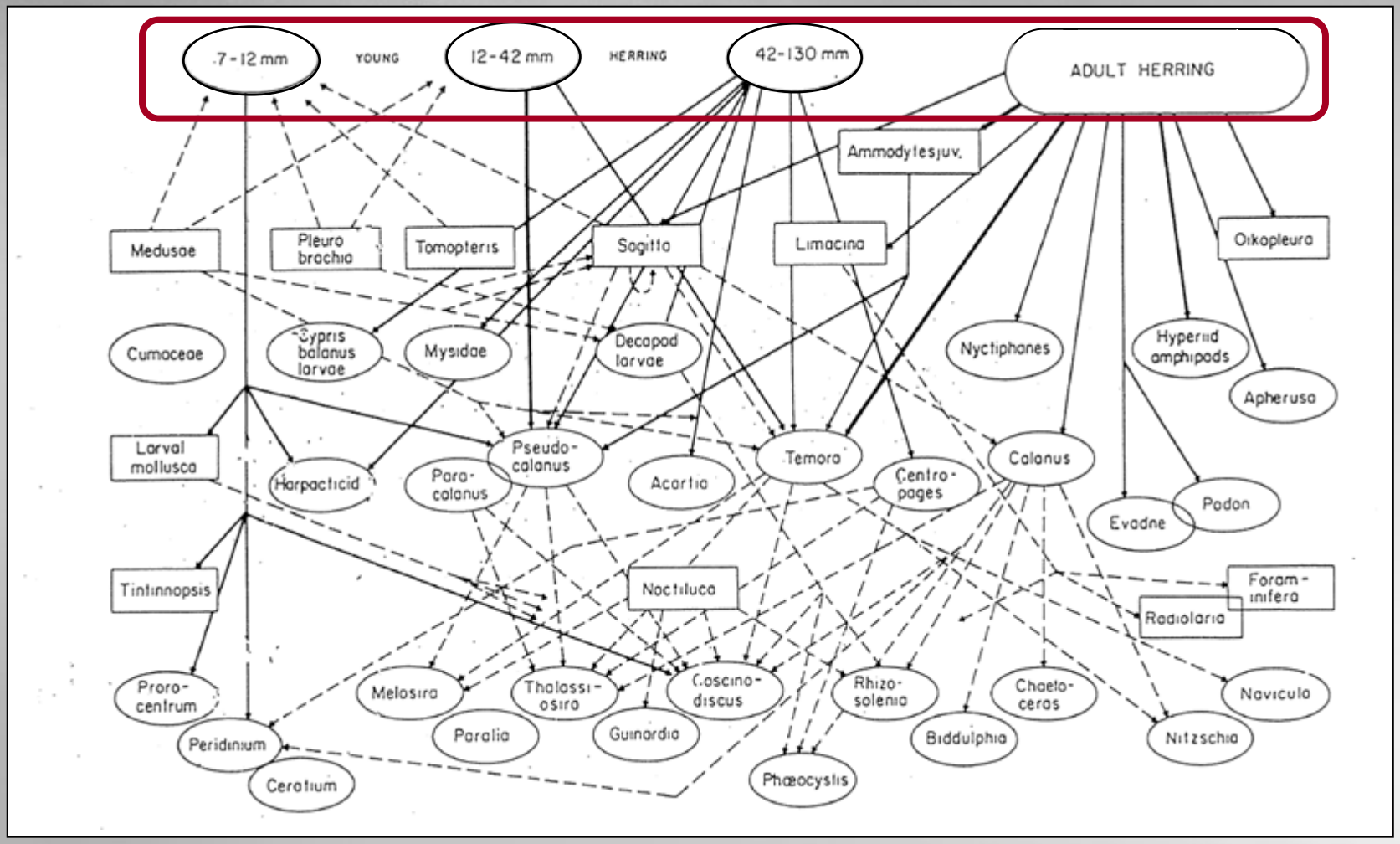


https://eapbiofield.wikispaces.com/file/view/55_14cNitrogenCycle-L.jpg



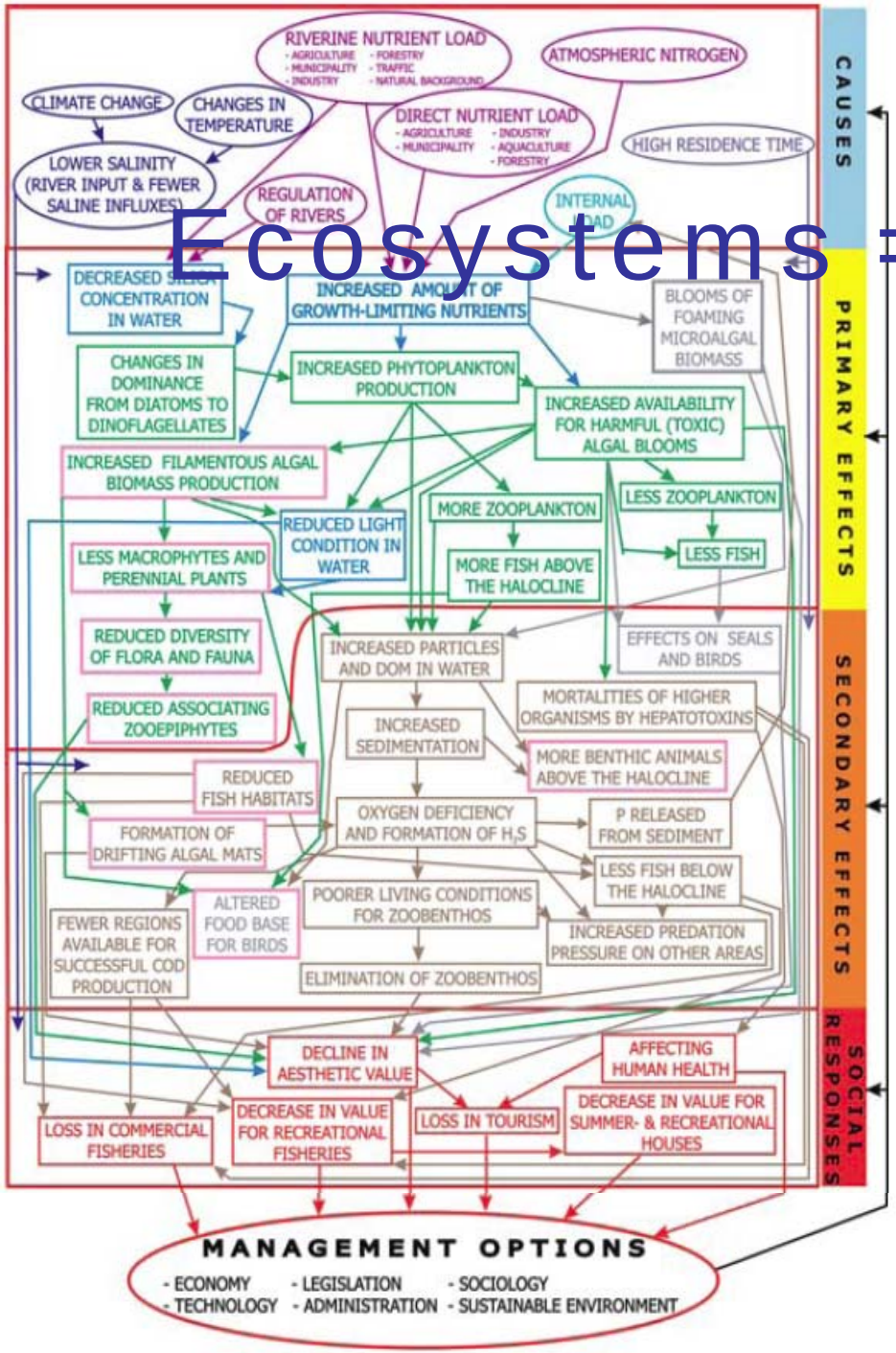
UNEP/GRID Arendal Maps and Graphics Library, *World's water cycle: schematic and residence time*, http://maps.grida.no/go/graphic/world_s_water_cycle_schematic_and_residence_time

Ecosystems = networks

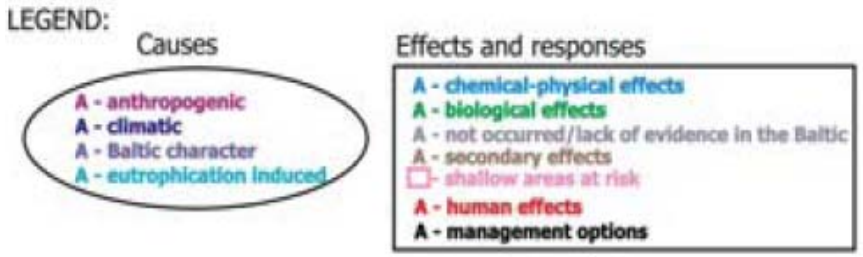


From D H Cushing and J J Walsh (1976) “Ecology of the seas”

Ecosystems = networks

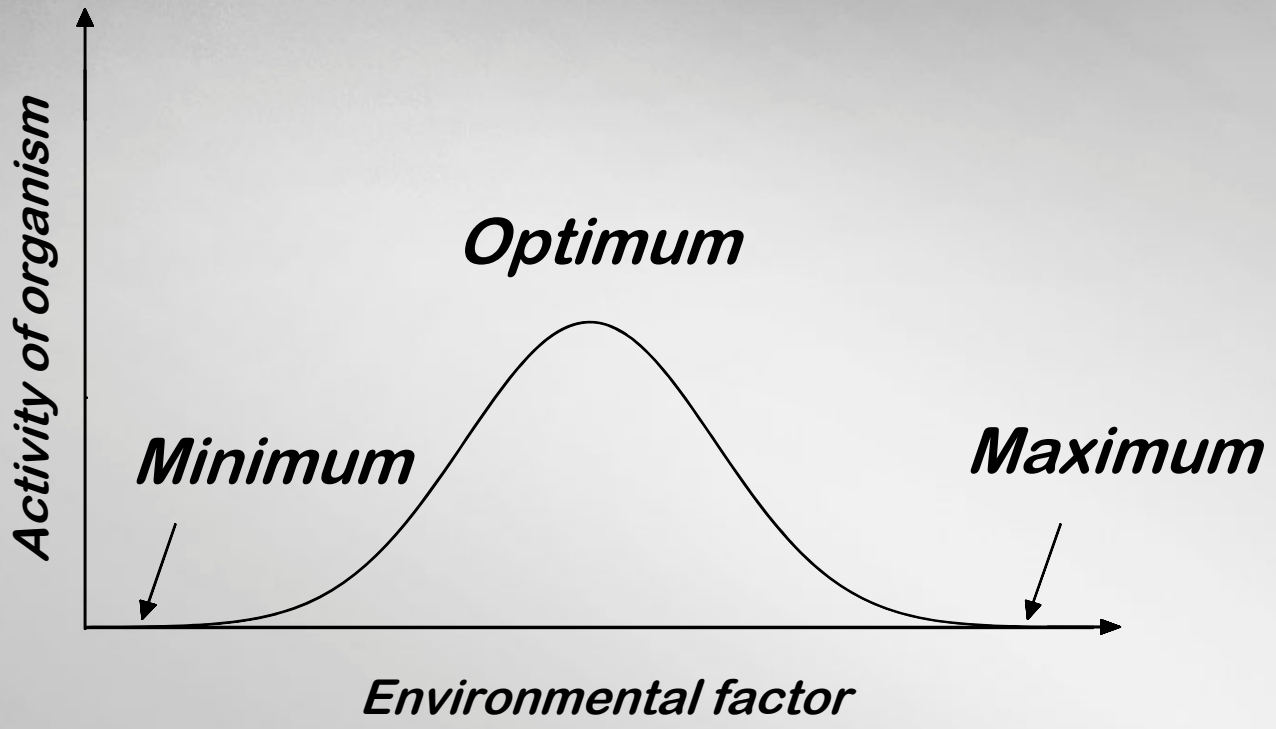


Another Example:
The Eutrophication of the Baltic Sea Ecosystem

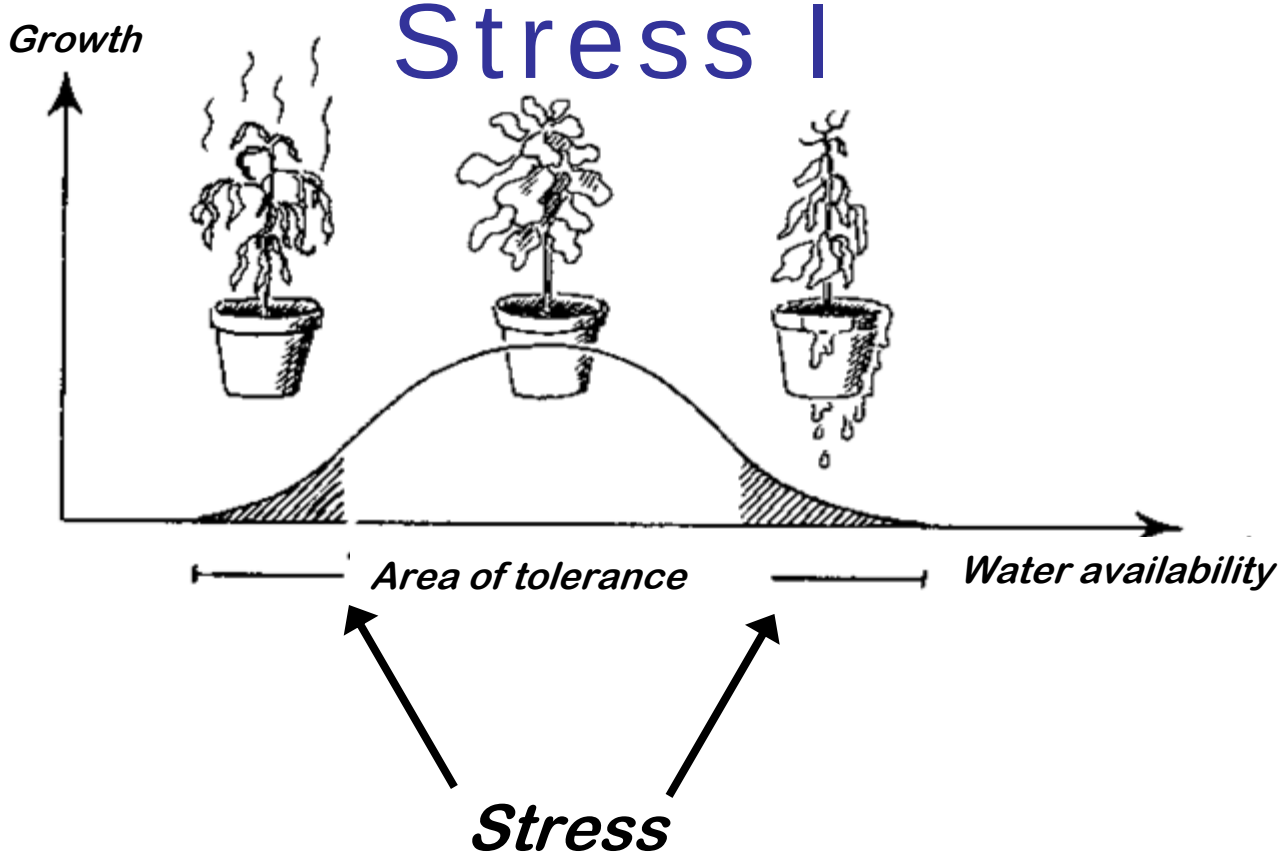


From C Lundberg (2005) Ambio 34, 433-439

Background - the optimum curve

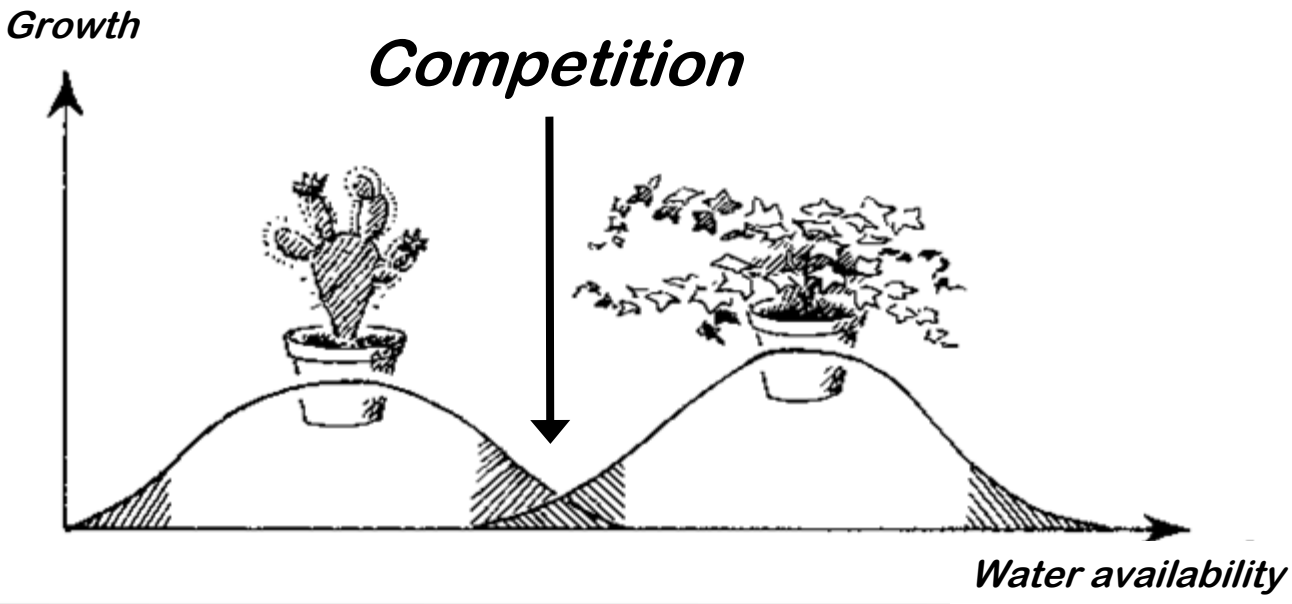


Stress I



(From Pleijel, 1991)

Stress II



(From Pleijel, 1991)

Stress and stressors

Stress - a biological definition

Stress is
one or many external factors,
biotic or abiotic,
which are restricting

- resource acquisition
- growth
- reproduction

(of an individual
belonging to a population
of a species)

Variation and selection

Ecosystems – a mess

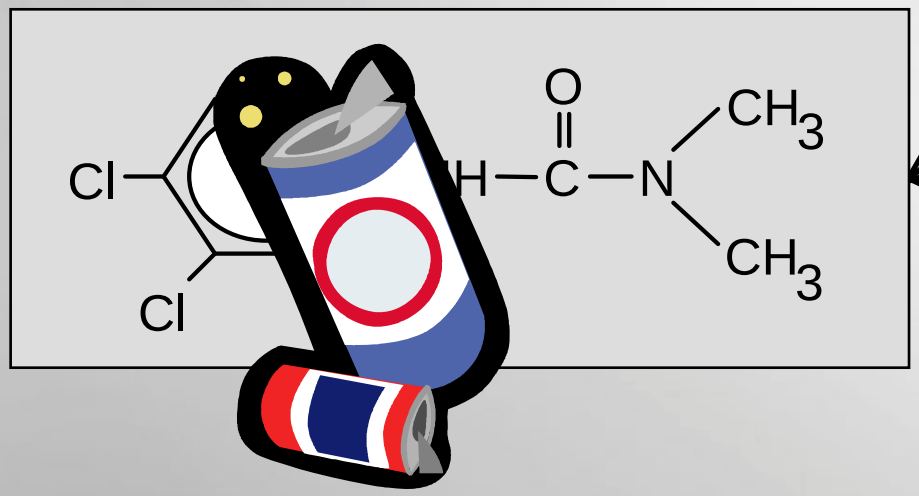
Yarn bombing from Art Today http://blog.lib.umn.edu/rwittig/arttoday/2009/02/yarn_bombing.html
Context free spiral from Wikimedia Common http://commons.wikimedia.org/wiki/File:ContextFree_SpiralTree.png

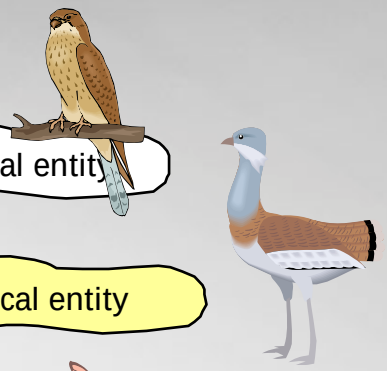
Assessing effects on ecosystems...

we cannot escape...

- Simplifications
- Choice of
  - scope (of assessments)
  - system boundaries

The main perspective...





Ecological entity

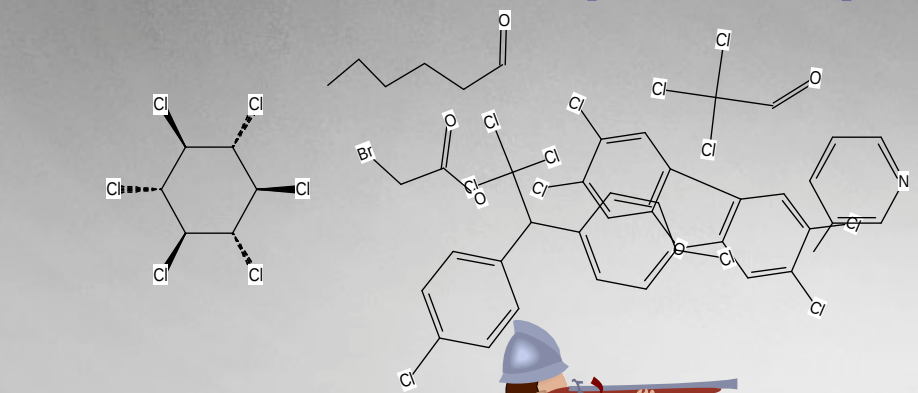
Ecological entity

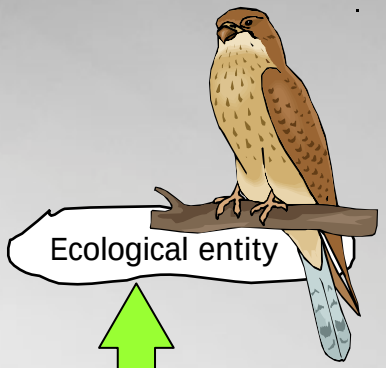
Ecological entity

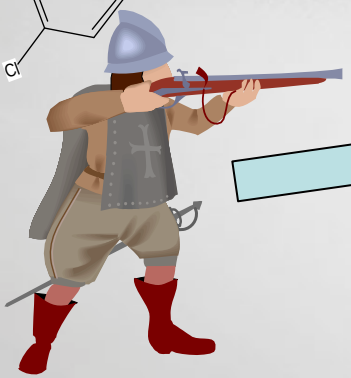
Ecological entity

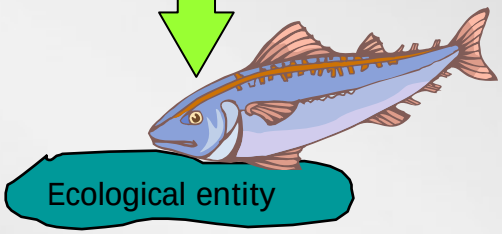
Ecological entity

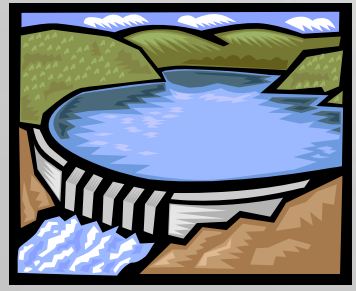
Another perspective...











Cause effect chains

Source(s)

Pathway(s)

Receptor(s) & Effect(s) on receptor(s)

STRESSOR SOURCES THAT GIVE EMISSION OF STRESSORS TO ENVIRONMENTAL COMPARTMENT(S)

⇓

DISPERSAL & ENVIRONMENTAL DISTRIBUTION (PED)

⇓

(BIOTIC AND) ABIOTIC TRANSFORMATIONS

⇓

ENVIRONMENTAL CONCENTRATION (PEC)

⇓

EXPOSURE OF ORGANISMS

⇓

UPTAKE BY ORGANISMS

⇓

METABOLISATION/EXCRETION/ACCUMULATION

⇓

EFFECTS ON ORGANS/RECEPTORS

⇓

EFFECTS ON INDIVIDUAL "FITNESS"

⇓

EFFECTS ON POPULATIONS

⇓

EFFECTS ON ECOSYSTEM STRUCTURE AND FUNCTION

Example – a chemical stressor

Basic assumptions - cause-effect

STRESSOR SOURCES THAT GIVE
EMISSION OF STRESSORS TO ENVIRONMENTAL COMPARTMENT
⇓
DISPERSAL & ENVIRONMENTAL DISTRIBUTION (PED)
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(BIOTIC AND) ABIOTIC TRANSFORMATIONS
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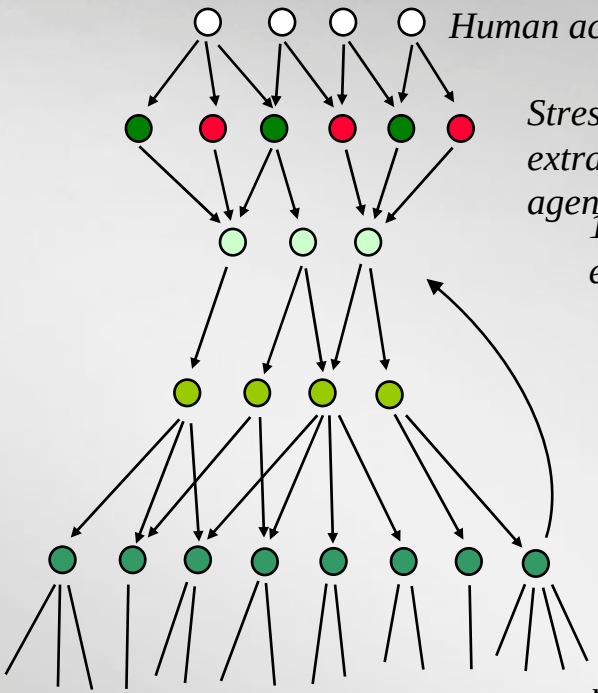
EFFECTS ON POPULATIONS
⇓
EFFECTS ON ECOSYSTEM STRUCTURE AND FUNCTION



Cause-effect chain vs. Cause-effect network/cascade

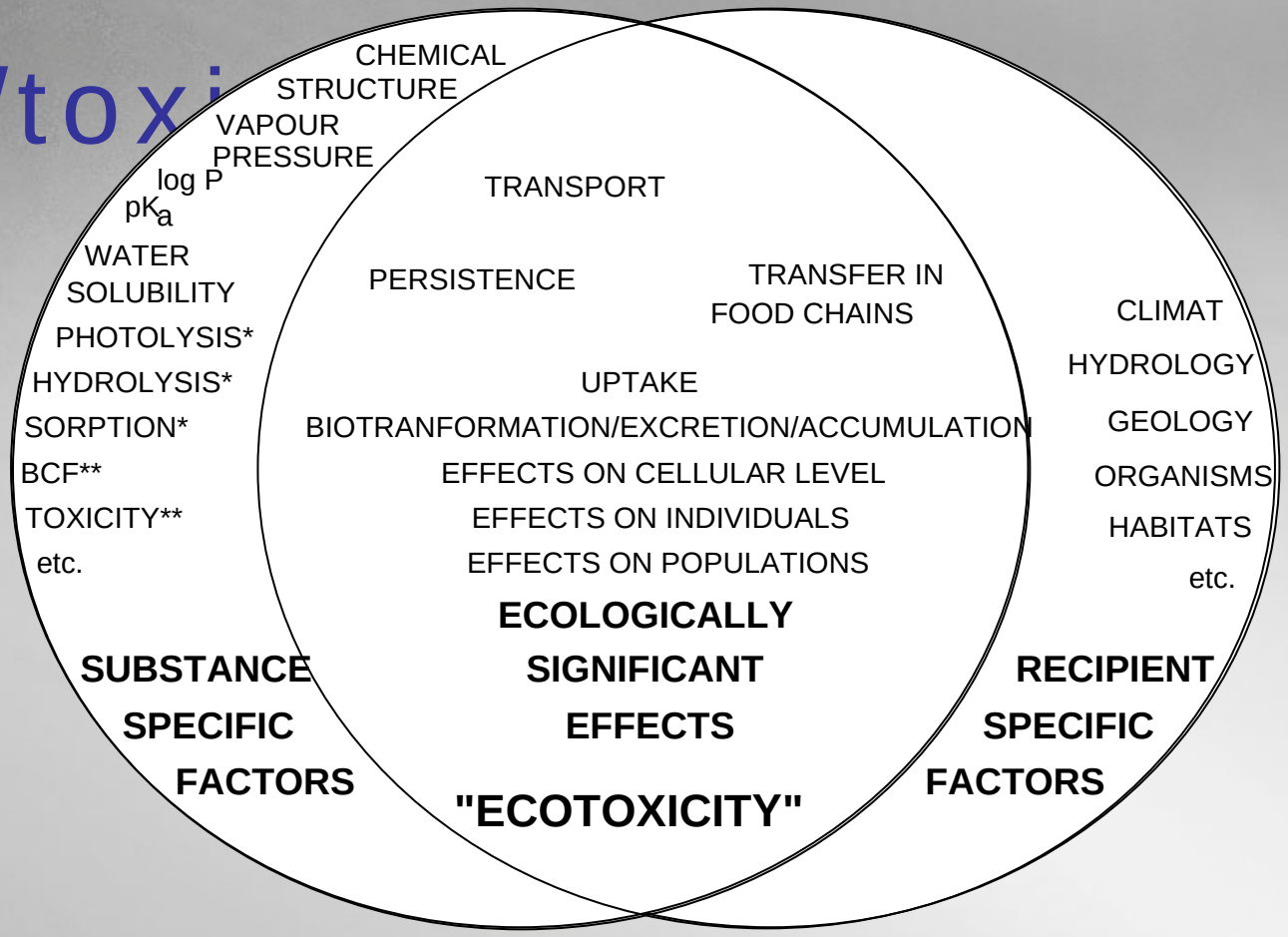
Ecosystems – a mess!

Yarn bombing from Art Today http://blog.lib.umn.edu/rwittig/arttoday/2009/02/yarn_bombing.html
Context free spiral from Wikimedia Common http://commons.wikimedia.org/wiki/File:ContextFree_SpiralTree.png

Simplifications in test systems

TEST SYSTEM	ECOSYSTEM
often only one species	many interacting species
homogenous test population	heterogeneous populations
standardised medium	variable environment (pH *etc.*)
constant test concentration	variable toxicant concentrations
constant text conditions	biological degradation
artificial light	variable light
short exposure (days)	long-term exposure (months, years)
constant sensitivity	variable sensitivity
near optimal (“stress-free”) conditions, except for the tested compound	sub-optimal (“stressful”) conditions, many stressors (toxicants and other)

Eco/toxi



Ecotoxicity ***is not*** an absolute, easily measurable inherent property of a chemical compound,

but a relative and ***emerging property***; **a result of an interaction between a compound and an exposed organism in a particular situation.**

Science and management...