

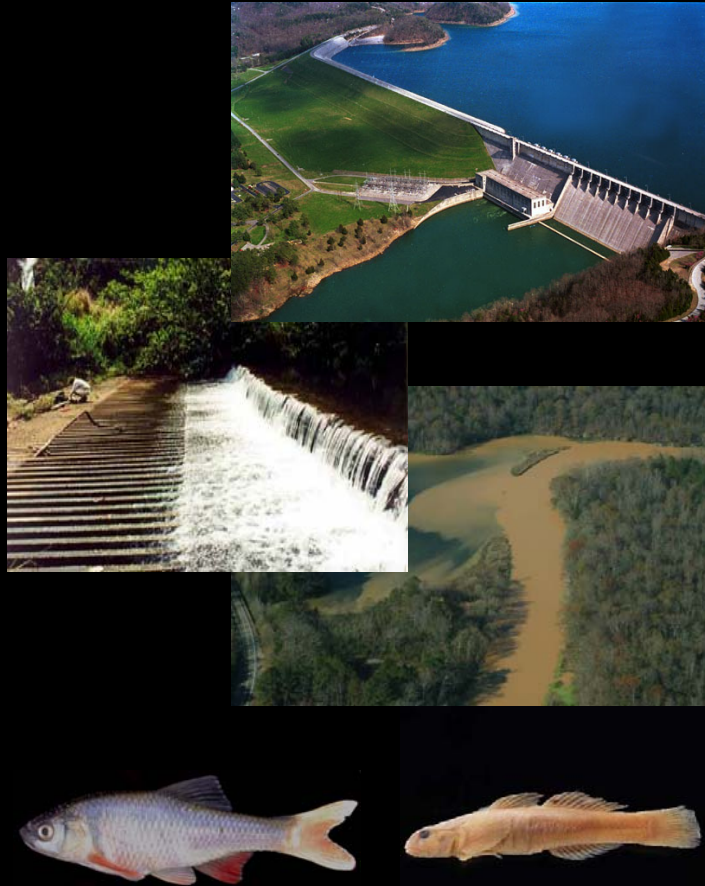
Assessing population and species level effects of environmental contaminants

Michael J. Blum¹ & Evon Hekkala¹

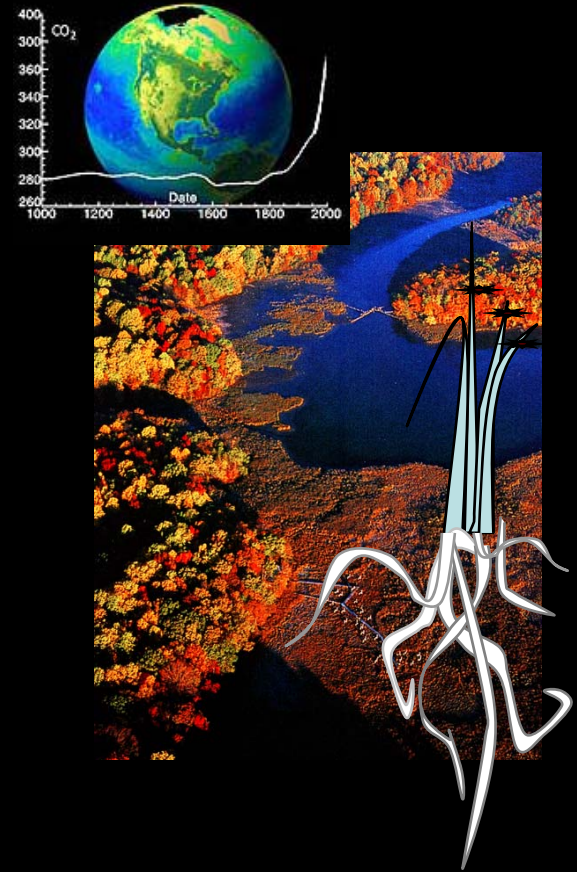
David M. Walters², Brady A. Porter³, Noel M. Burkhead² and Byron J. Freeman⁵



Organismal responses to contemporary environmental change



**The influence of land use
& water management on fishes**



**The influence of climate
stressors on coastal marshes**

Do environmental contaminants elevate population or species vulnerability?



Physical drivers like sedimentation

Chemical drivers like EDCs & heavy metals

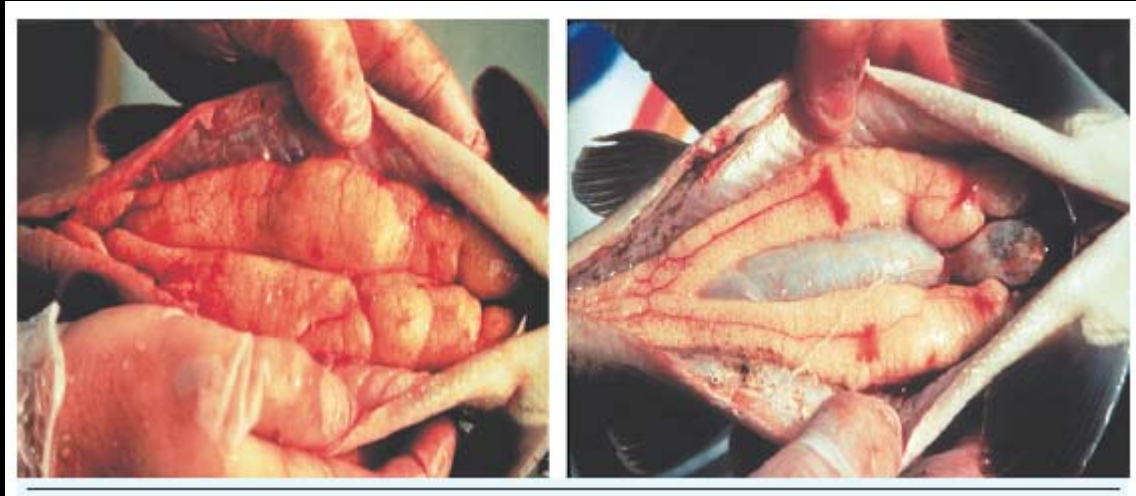
How do individual-level responses emerge at the population and species level?



Do populations vary in response?

If so, is variation attributable to genetic or environmental factors?

How do individual-level responses emerge at the population and species level?



Reduced ovarian size in white suckers following exposure to Bleached Kraft Mill Effluent

Organismal level effects of exposure:

Induced gene expression (vitellogenin)

Sex modification (intersex individuals)

Behavioral modification

How do individual-level responses emerge at the population and species level?



Prezygotic



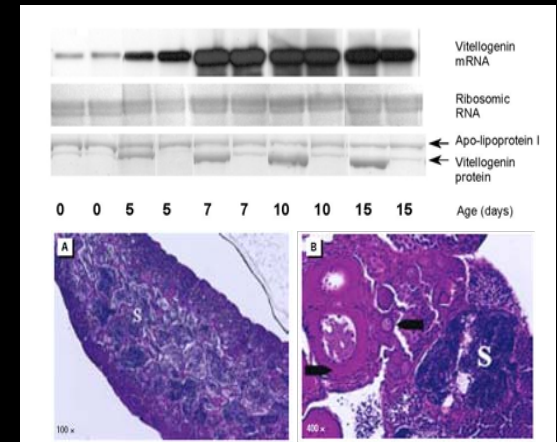
**Post-mating
prezygotic**



Postzygotic

Estimating the effects of lead exposure on fitness at three stages of reproduction

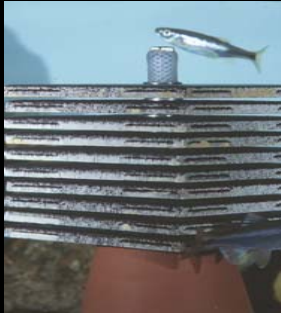
How do individual-level responses emerge at the population and species level?



2 & 8 week exposures to lead concentration gradient

Biomarker & histological assays during development

How do individual-level responses emerge at the population and species level?



Male- Male aggression



Exposed vs. control males



Female- Male aggression

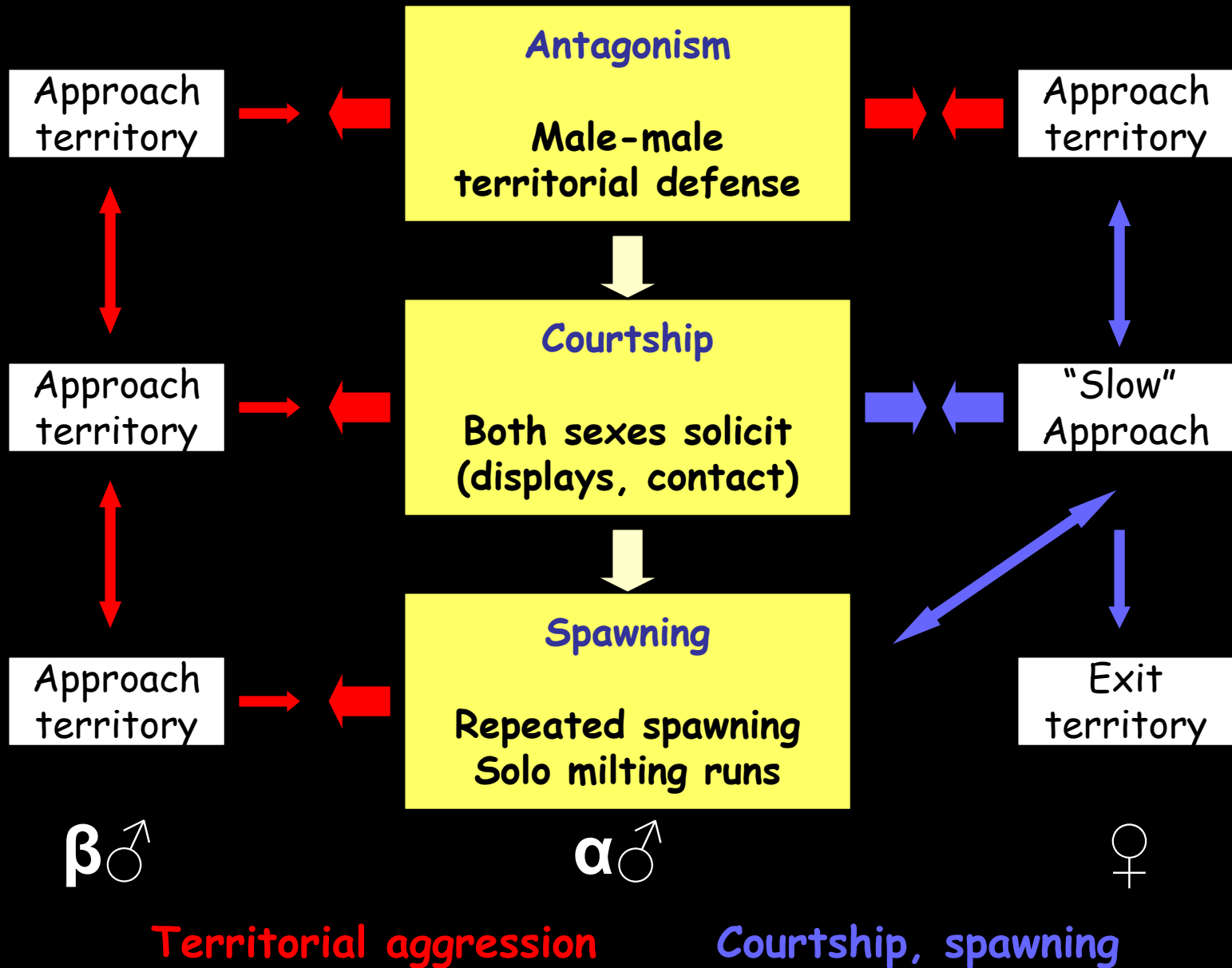


Exposed vs. control males / females

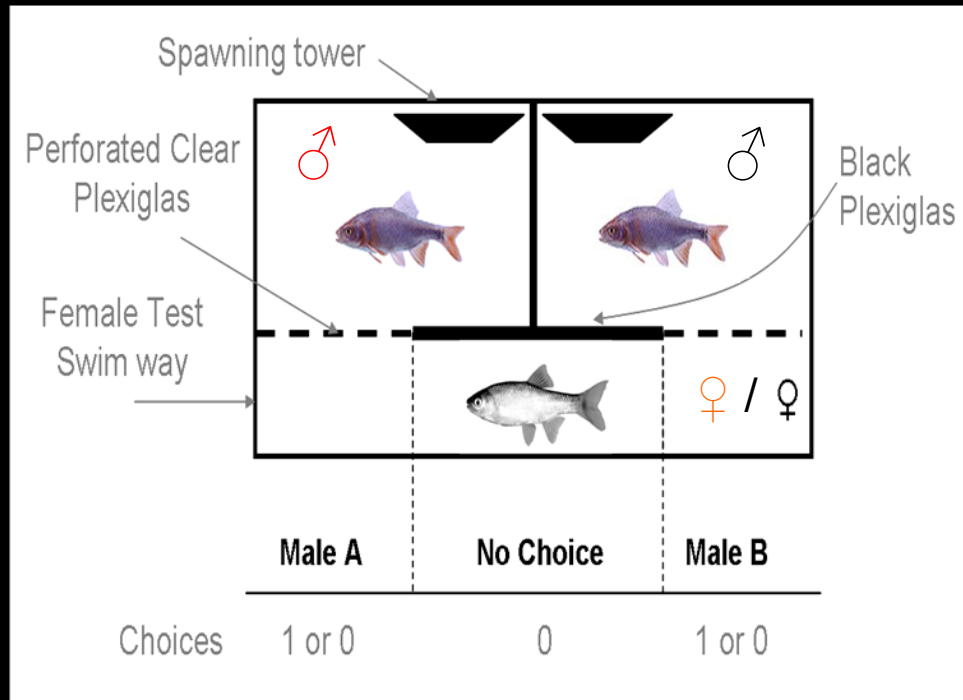


Exposure may impact levels of aggression during spawning

Sorting and establishment of spawning hierarchy



How do individual-level responses emerge at the population and species level?



Exposure may impact courtship & selection during spawning

How do individual-level responses emerge at the population and species level?



Brood size



Fertilization

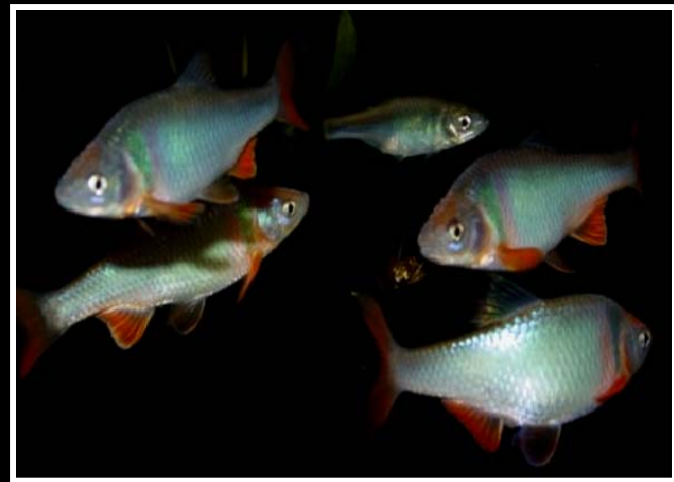


Maturation

Estimating the effects of lead exposure on fitness from egg development to larval maturation

Do populations vary in response?

If so, is variation attributable to genetic or environmental factors?



Population A



Population B

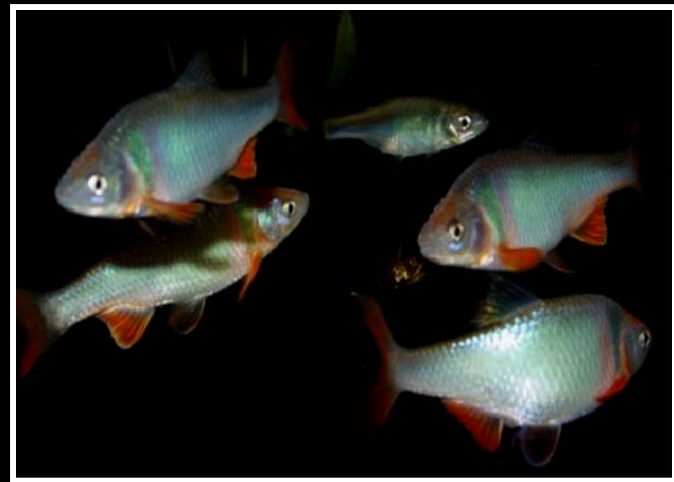


Population C

Effects on aggression and courtship may vary across populations due to differences in susceptibility

Do populations vary in response?

If so, is variation attributable to genetic or environmental factors?



Population A
Population A



Population B
Population B



Population C
Population C

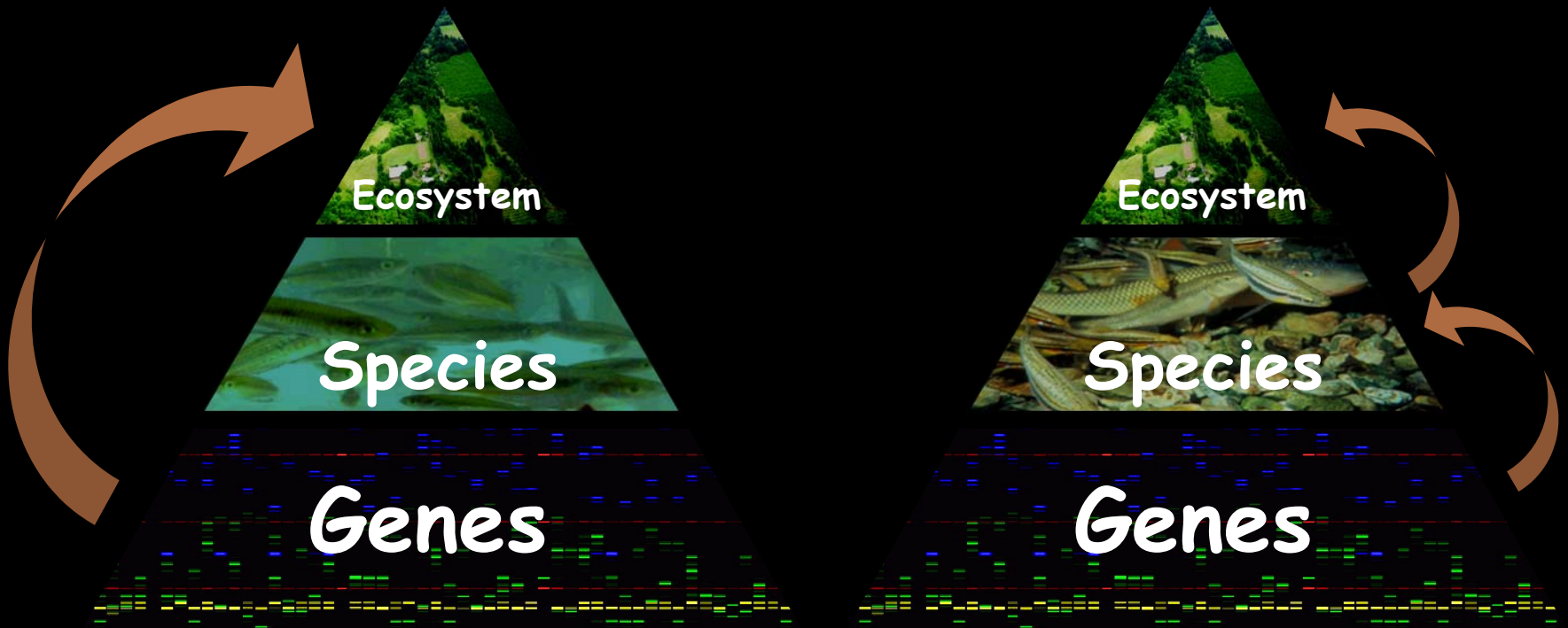
Replicate experiments involving multiple populations of two species
Common garden conditions to control environmental variation

Elevated vulnerability of populations & species may vary geographically



Physical drivers and chemical drivers can vary spatially and temporally

Environmental drivers of genetic change can induce ecosystem change



Bottom-up, system-wide effects of exposure on ecosystems?