

Population-Level Ecological Risk Assessment: Pesticide Registration Example

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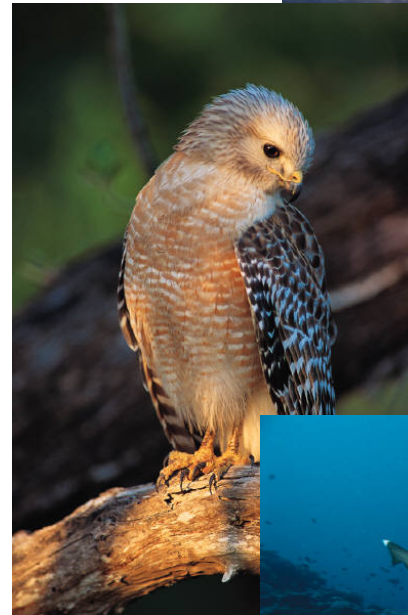
Presentation Objectives

- Illustrate modeling approaches undertaken to understand risks to populations of wildlife & aquatic life
- Highlight transferable issues & challenges



Outline

- Why populations?
- Population models for risk assessment
- Pesticide scenario
 - regulatory context
 - evolving systems of models
- Transferable issues & challenges



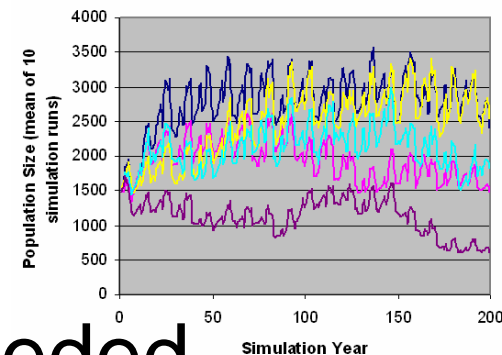
Populations as Assessment Endpoints

- Responsive to intent of legislation & policy
 - “to sustain fish, shellfish, and wildlife populations” (CWA)
 - “ecological effects of most concern are those that can impact populations” (Ecological Risk Assessment Guidance for Superfund)
- Often reflect management goals & objectives (sustainability)
- Responsive to societal values
- Places assessment in an ecological context
- Not responsive in all cases

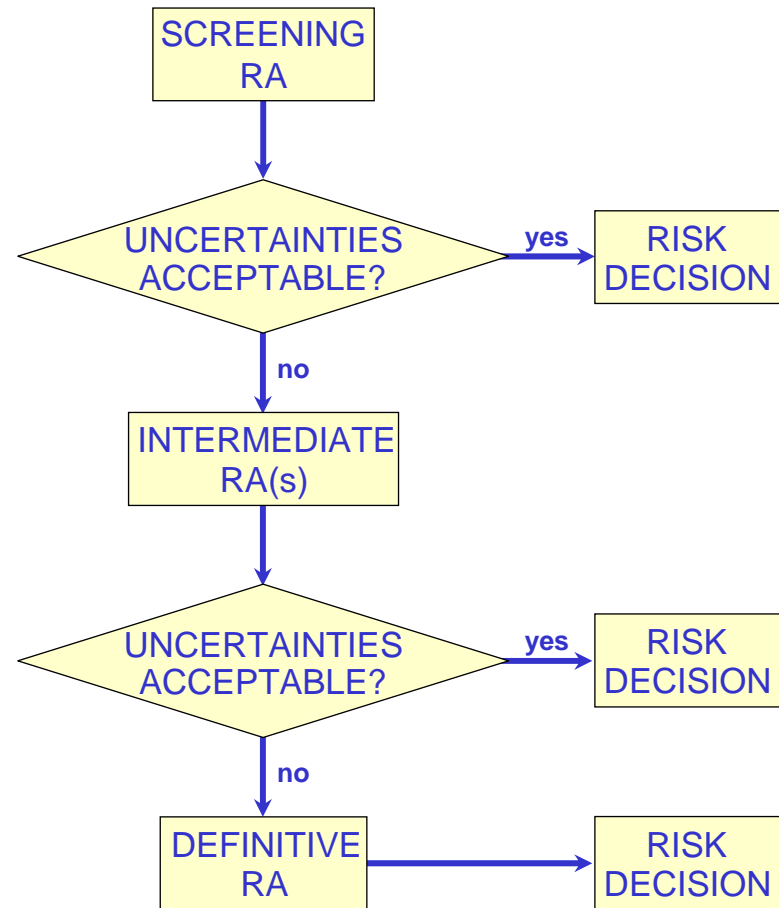
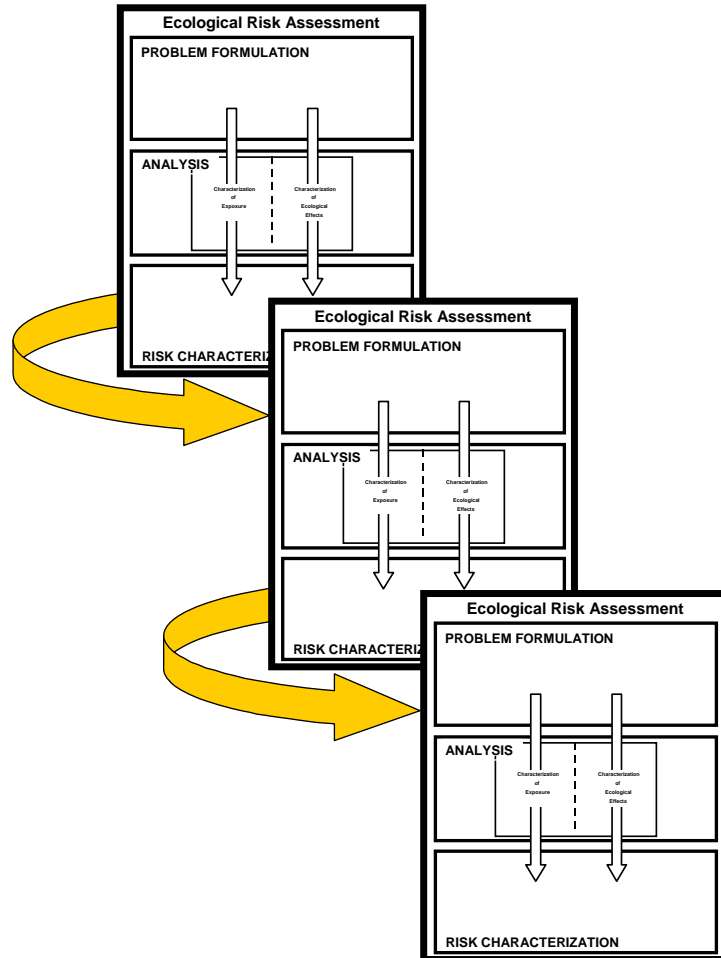


Modeling Population Risk

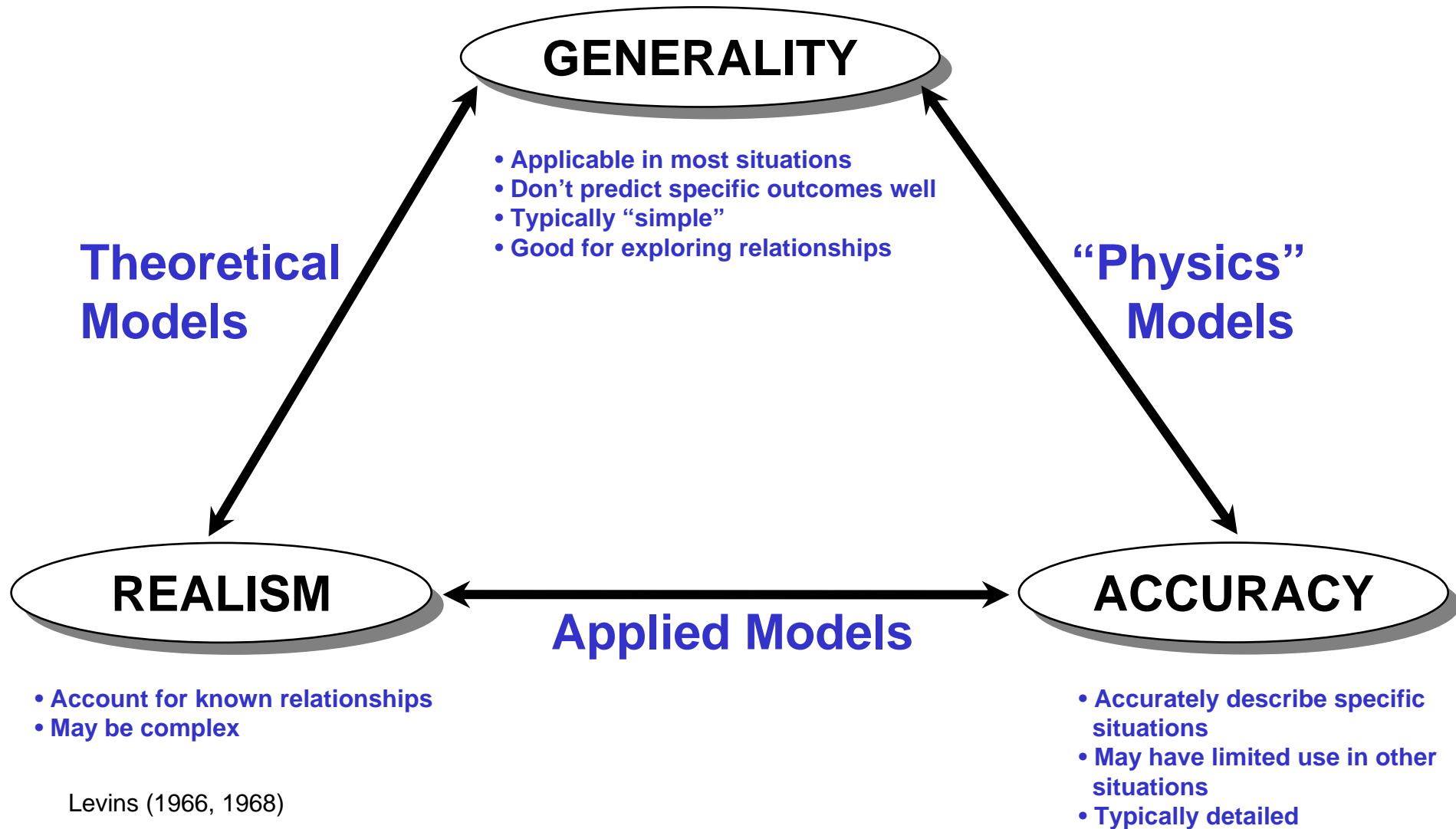
- Model selection requires:
 - definition of *population* & its attributes
 - spatiotemporal frames
 - responsive to management decision
 - consideration of relevant processes & interactions
 - environmental context
 - ecological context
- More than one model may be needed



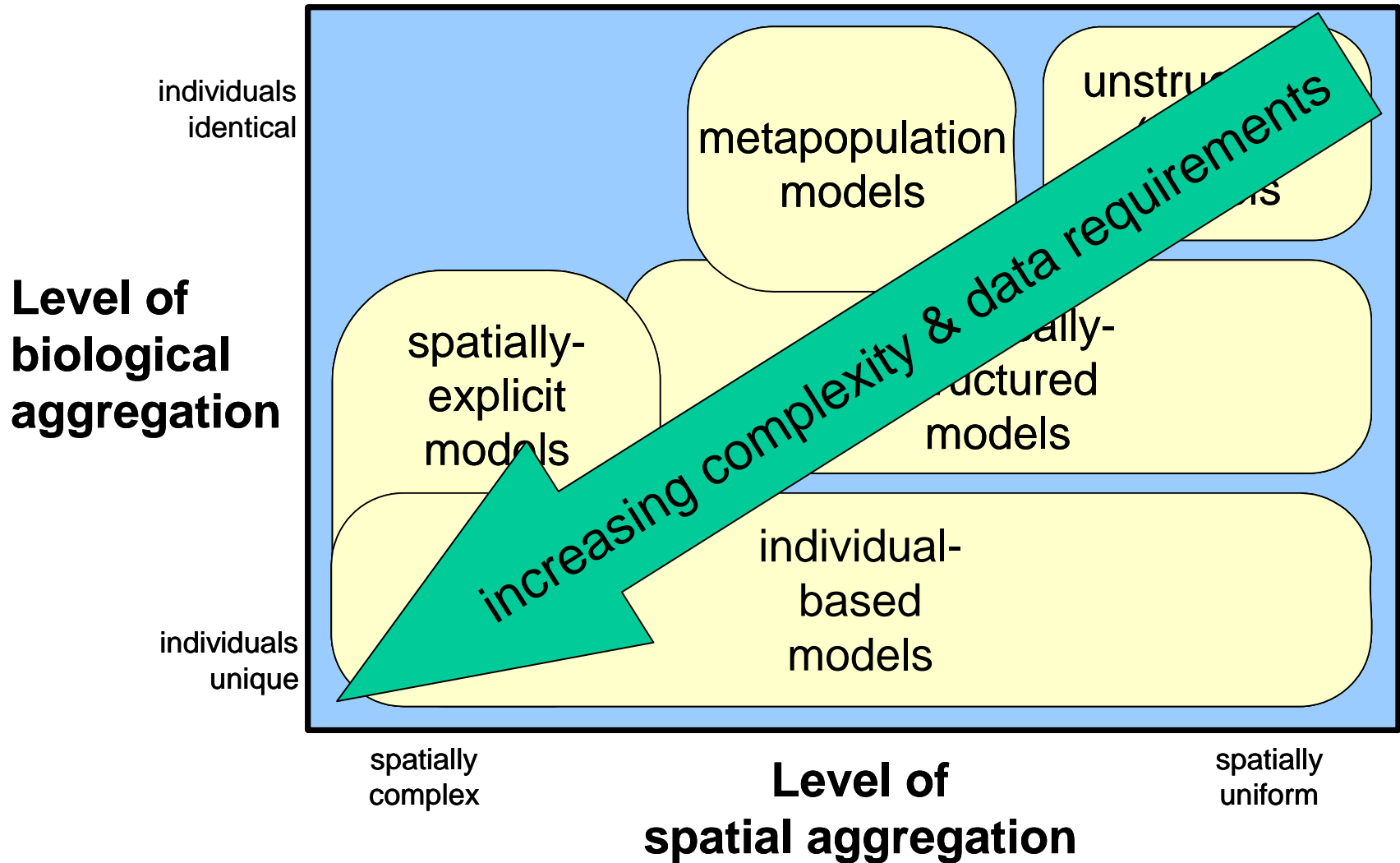
Tiering to Support Decisions



Models for Different Uses



Population Models

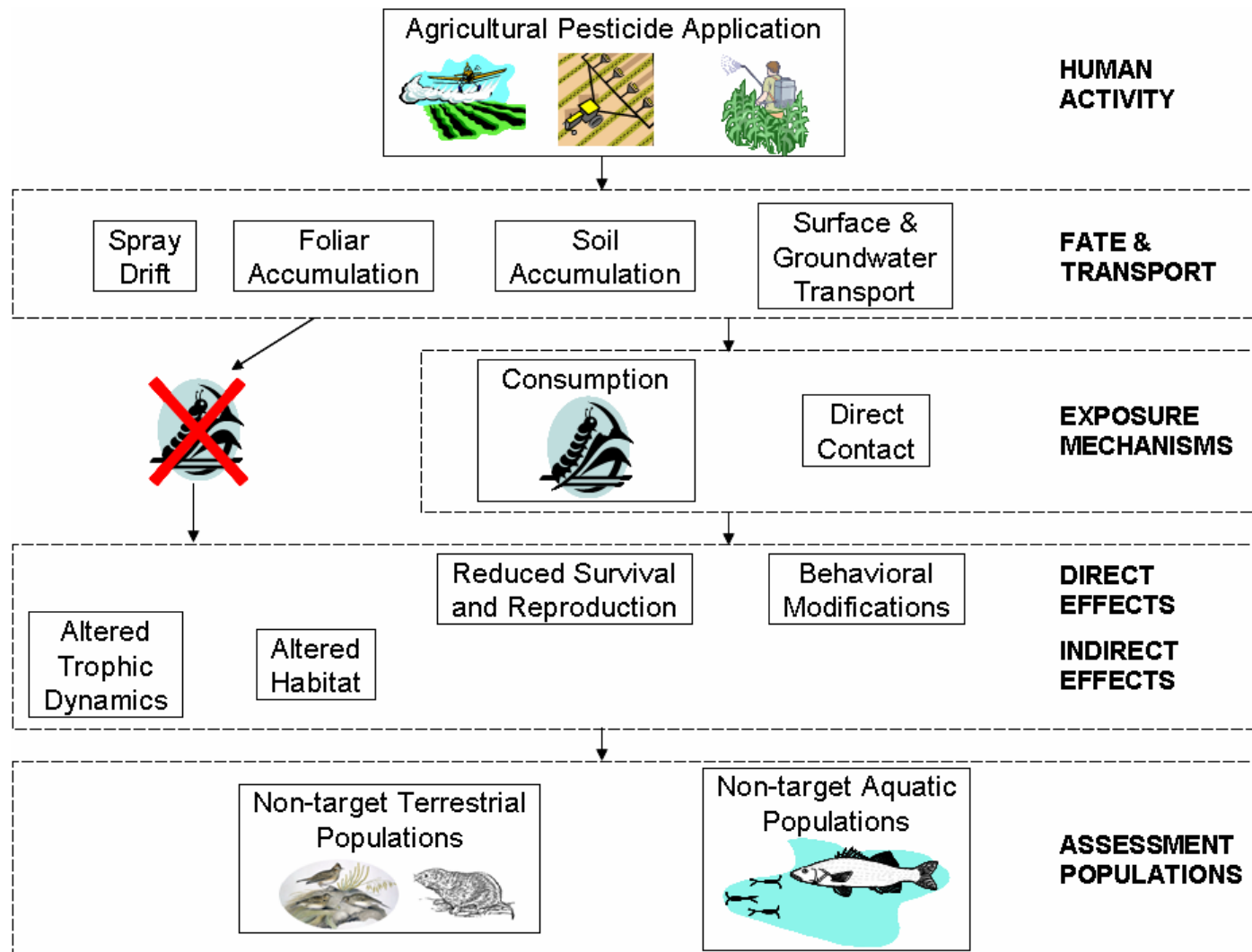


A Pesticides Example

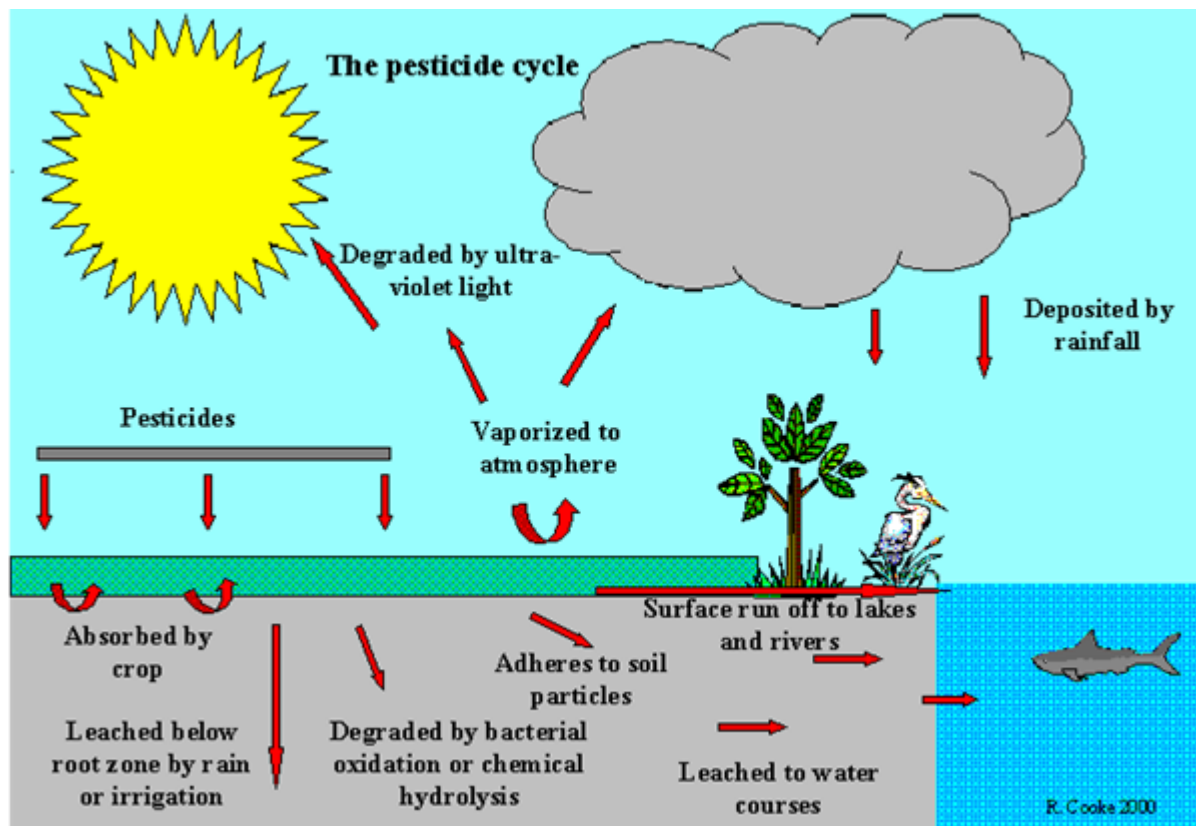
- Regulated in US under Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) to prevent “unreasonable adverse effects on the environment”
- Toxicity data & models used to evaluate risk to non-target species
- Moving towards risk to populations



Conceptualization of Problem

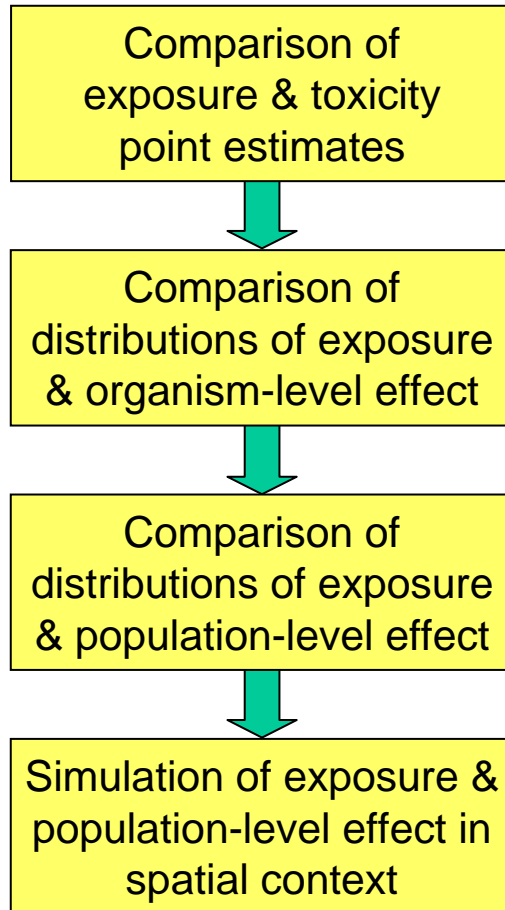


System of Exposure Models



- Spray drift
- Runoff
- Surface water
- Ground water

Refinements to Assessment Approach



conservatism

realism

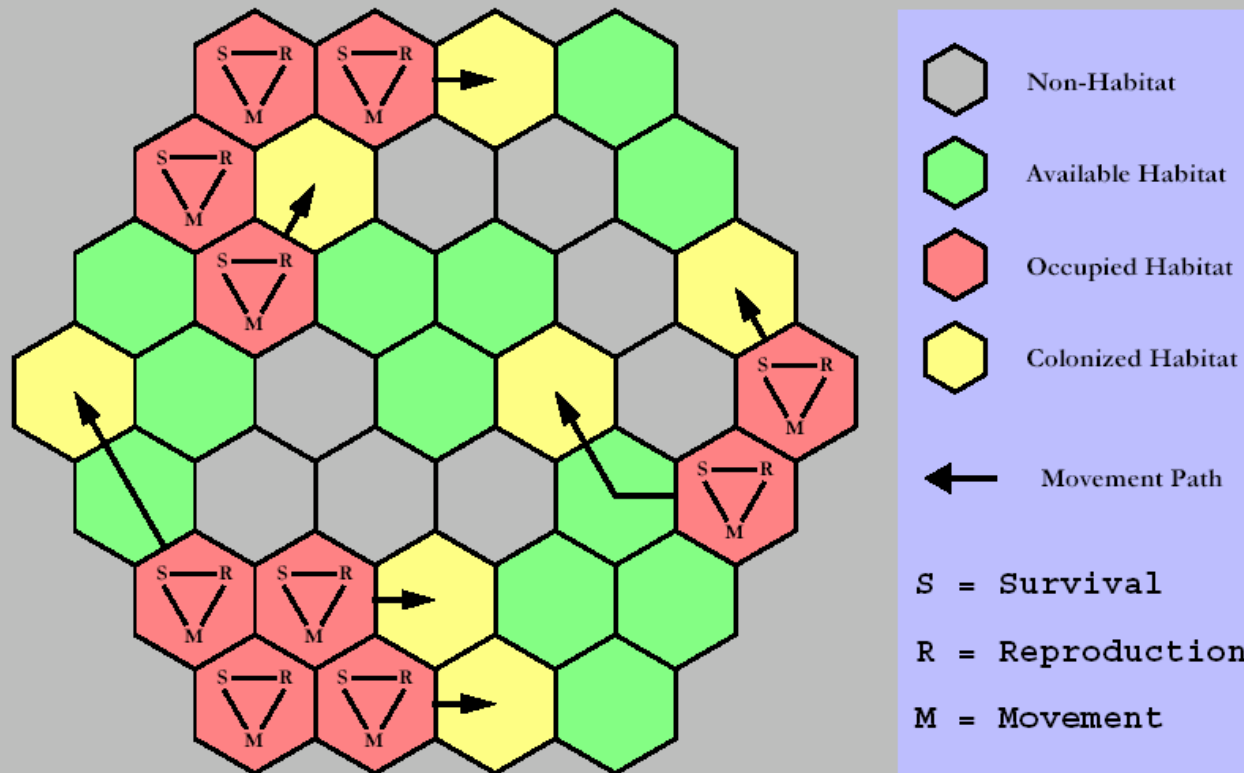
complexity

issues of model integration



Spatially-dependent Modeling – PATCH

The Model's Movement Process Serves to Link a Collection of Individuals Together Into a Population



- Can model real landscapes
- Pesticides change S, R & M depending on exposure level
- Models multiple attributes
- Requires description of exposure spatially

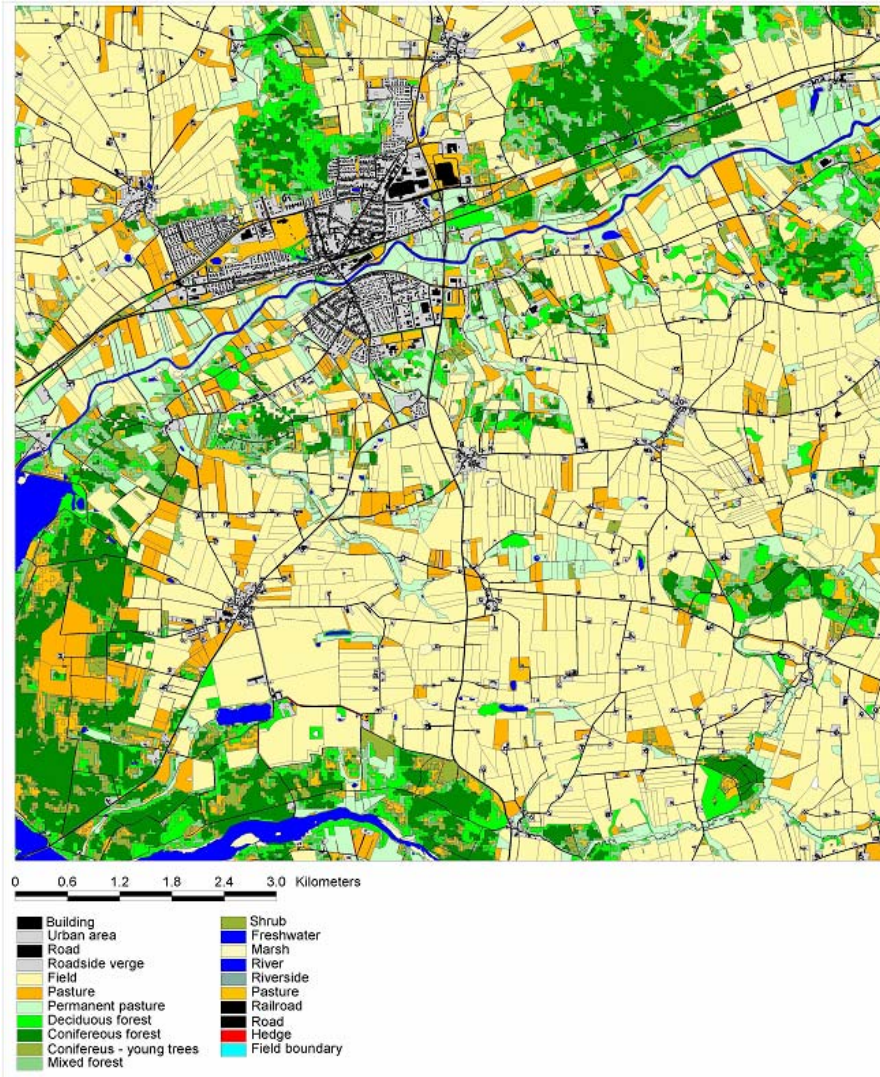
courtesy of
N. Schumaker



RESEARCH & DEVELOPMENT

Building a scientific foundation for sound environmental decisions

A Different Kind of Integration – ALMaSS



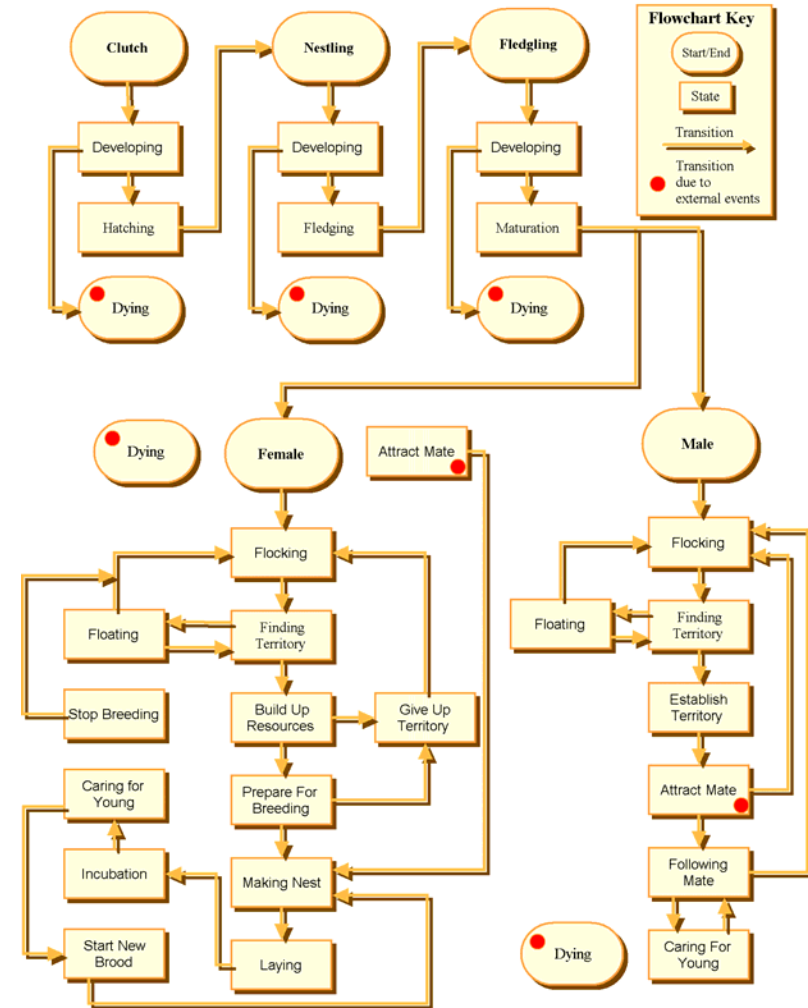
- Detailed GIS, including roadside verges, field boundaries & hedgerows
- Fields assigned to farms and farms to farm types & practices
- Seasonal and daily variation in traffic load on all roads
- Soil type, slope and aspect of all areas
- Subdivision of forested areas
- Weather data

courtesy of
C. Topping



An Agent-based Model

- Simulation
 - farming practices
 - weather & other aspects of environment
 - ecological phenomena
- Biology responds at each time step
 - direct
 - indirect
- Models multiple attributes & nonlinearities



courtesy of C. Topping

Transferable Issues & Challenges

- Population effects module:
 - data voids – extrapolation, surrogates
 - spatial context & heterogeneity
 - stochasticity
 - density dependence
 - population genetics
 - species interactions
 - multiple stressors
- Linking to physical & chemical modules
 - spatiotemporal scales
 - characteristic time steps (if simulations)

