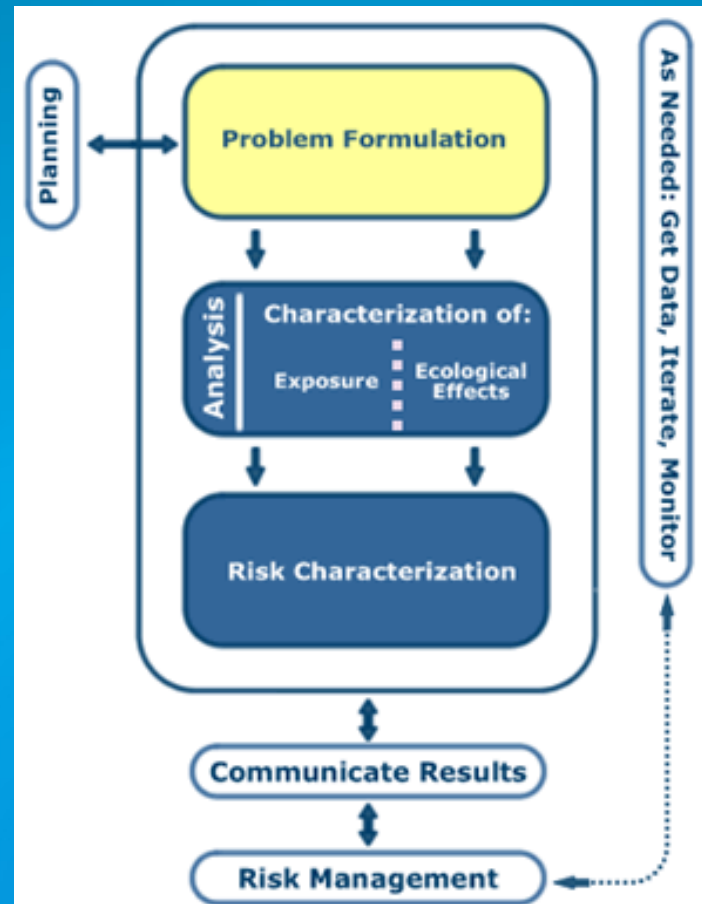


Challenges of Ecological Risk Assessment for Chemicals

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LWB Environmental Services, Inc.

AERC-IUR Workshop
Aiken, SC
October 3, 2016

Ecological Risk Assessment: Organizing Scientific Information to Inform Environmental Management



There are Many Kinds of Ecological Risk Assessments for Chemicals

- New Chemical Registration
 - Limited toxicity data
 - Heavy reliance on structure-activity relationships
- Existing Chemical Review
 - Limited toxicity data
 - Heavy reliance on use data and environmental fate modeling
- Pesticide Registration
 - Toxicity data for multiple species
 - Mesocosm tests
 - Measured environmental concentrations
 - Heavy reliance on environmental fate modeling
 - More recently, population models
- Contaminated site assessment
 - Intensive sampling of sediment, soil, and water
 - Biological surveys
 - Literature-derived toxicity data
 - Site-specific toxicity tests
 - Environmental fate modeling common, ecological effects modeling rare

Where's the Ecology in Ecological Risk Assessment?

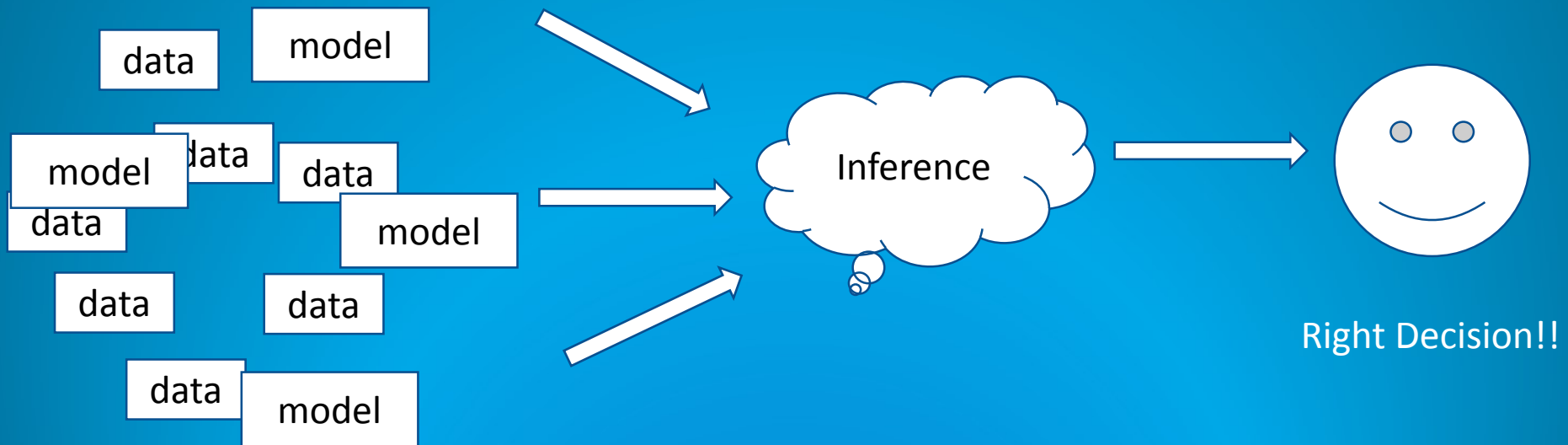
- “Effects Analysis” usually relies on single-species toxicity tests
 - Standard test species and life stages
 - Standard test protocols
- For some chemicals, “Effects Analysis” relies on molecular-level responses
 - AhR binding
- Field studies usually focus on measuring exposures or tissue residues; rarely on population or ecosystem characteristics
- Ecological models uncommon

Why Is it Missing?

- Ecosystems are diverse and complex
- Time and resources are limited
- Scientific understanding is limited
- Analysis methods are limited
- *Decisions can't wait!!*



The Challenge of Ecological Risk Assessment for Chemicals: Supporting Effective Environmental Management When Scientific Knowledge is Limited



Meeting the Challenge: Effective Institutional Resources and Processes

Institutional Resources

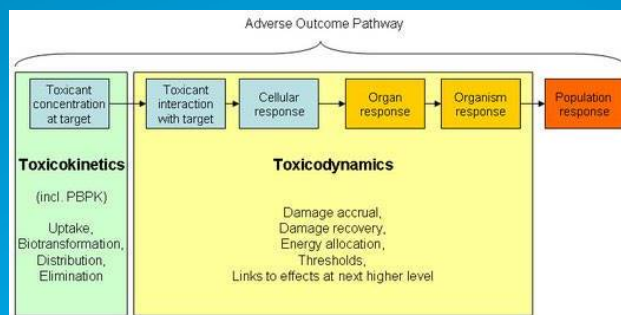
- Guidance documents
- Support resources
 - Regional BTAGs
- On-line models and databases
 - ECOTOX
 - CADDIS system
 - Aquatox

Institutional Processes

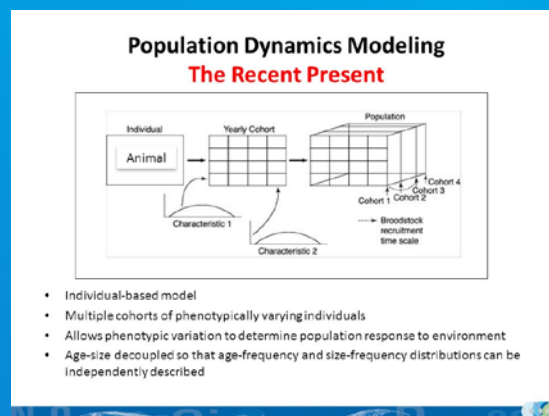
- DQO workshops
- Adaptive management

Meeting the Challenge: Better Science

- Mechanistic toxicology – beyond poisoning fish in a beaker

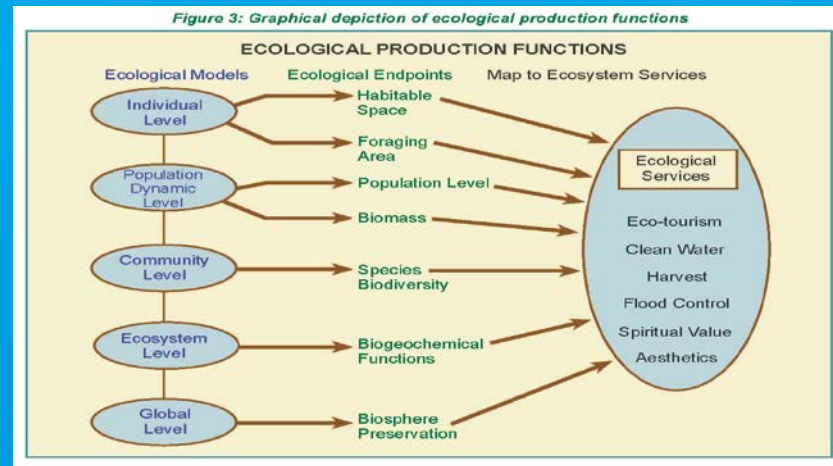


- Individual-based population models – linking individual-level toxicology to population-level effects



Meeting the Challenge: Ecosystem Services

- USEPA guidance documents
 - SAB report on ecosystem valuation (2009)
 - Risk Assessment Forum technical background document (2016)
- Frequent journal publications
 - *Environmental Toxicology and Chemistry*
 - *Integrated Environmental Assessment and Management*
- Few actual applications involving chemicals

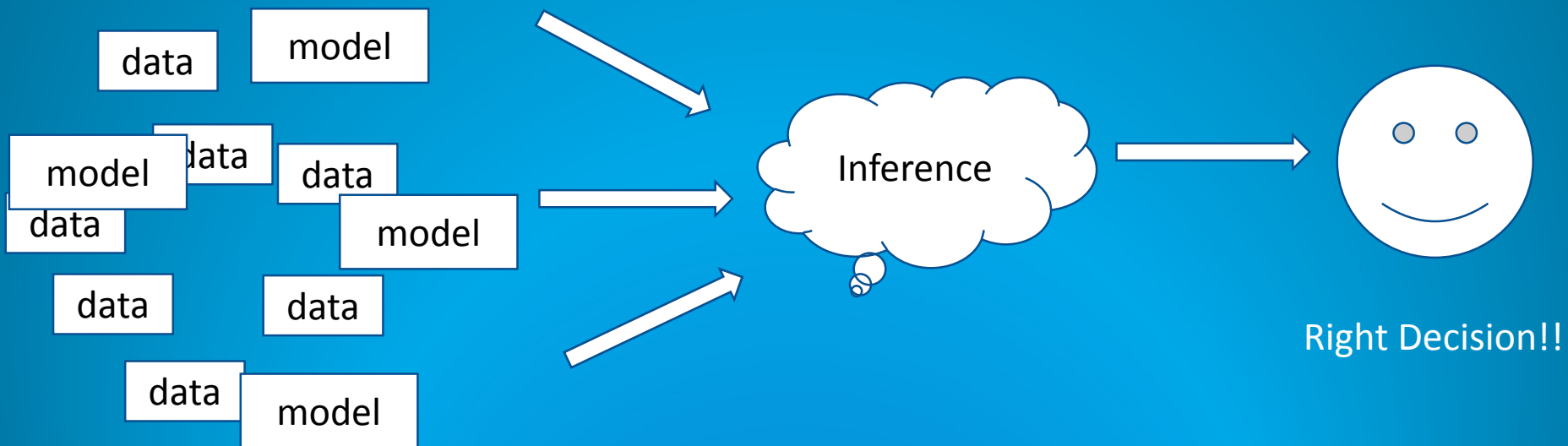


Ecological Data Collection is the Rate-Limiting Step

- Functional processes are difficult and expensive to measure
 - Time scales of interest vary from seconds to years
 - Spatial scales of interest vary from millimeters to kilometers $\times 10^3$
 - Processes at all scales are highly variable
- Remote sensing has already led to major advances, and drone technology promises to greatly increase the rate of data collection while lowering the cost



The Challenge of Ecological Risk Assessment for Radionuclides is the same as the Challenge for Chemicals



The Path Forward is Similar

- Effective Institutional Resources and Processes
 - IUR and ICRP activities
 - Collaborative workshops
 - Guidance documents
 - On-line tools
- Improved scientific information
 - Mechanisms of action
 - Organisms sensitivity
 - Environmental transport and fate
 - Effects at multiple levels of biological organization

Ecosystem Research is Key to Advancing Both Chemical and Radiological Ecorisk Assessments

- Better theory
- Better tools
- More data

Elephant in the
Room

