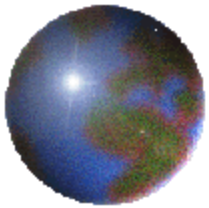
LAPRW 2011

3º Workshop Latinoamericano Sobre Residuos de Pesticidas Alimentos y Medio Ambiente

Montevideo, URUGUAY, Mayo 8 a11, 2011

# *Managing Pesticide Use to Protect Our Natural Environment*

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***Office of Pesticide Programs***
***US Environmental Protection Agency***
***Washington DC***


**3rd Latin American Pesticide Residue Workshop: Food and Environment**

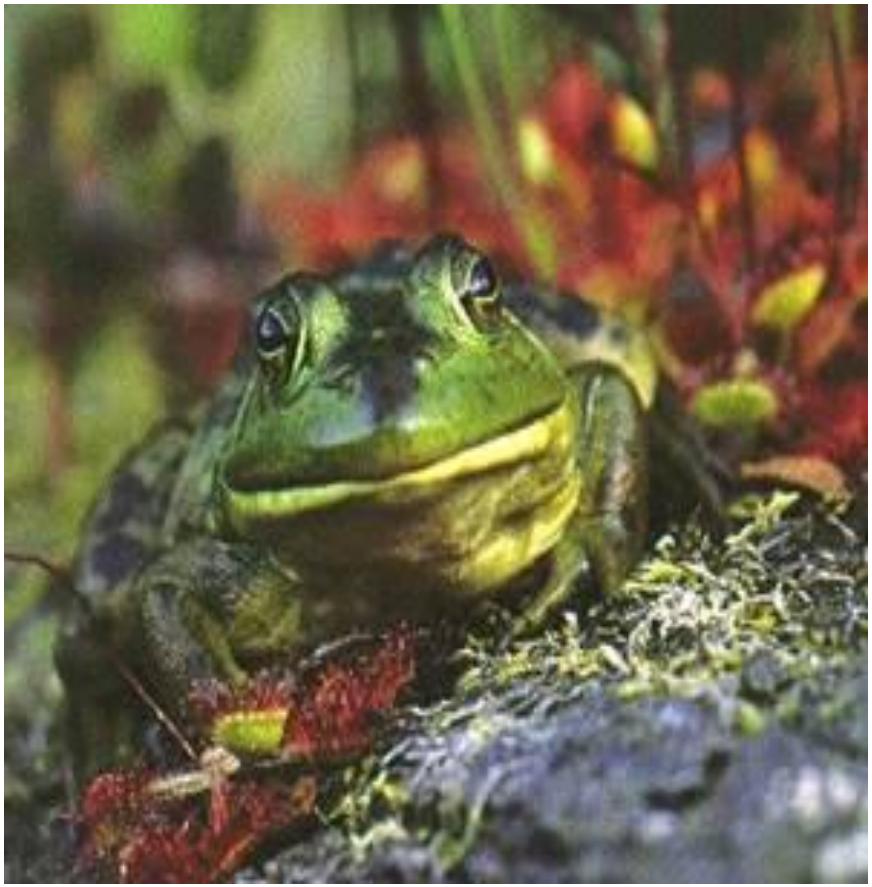
# Ecological Risk Assessment / Risk Management: Presentation Outline

- Ecological Risk Assessment (ERA): Why Do It? How Does It Work?
- Constraints to ERA Identified
- Possible Solutions Identified
  - Data Harmonization
  - Work-sharing
- Capacity-building; Capability-training
- User-friendly Exposure/Risk Assessment Methods & Tools
- Overall Goal: Risk Management

# Ecological Risk Assessment: Why Do It?

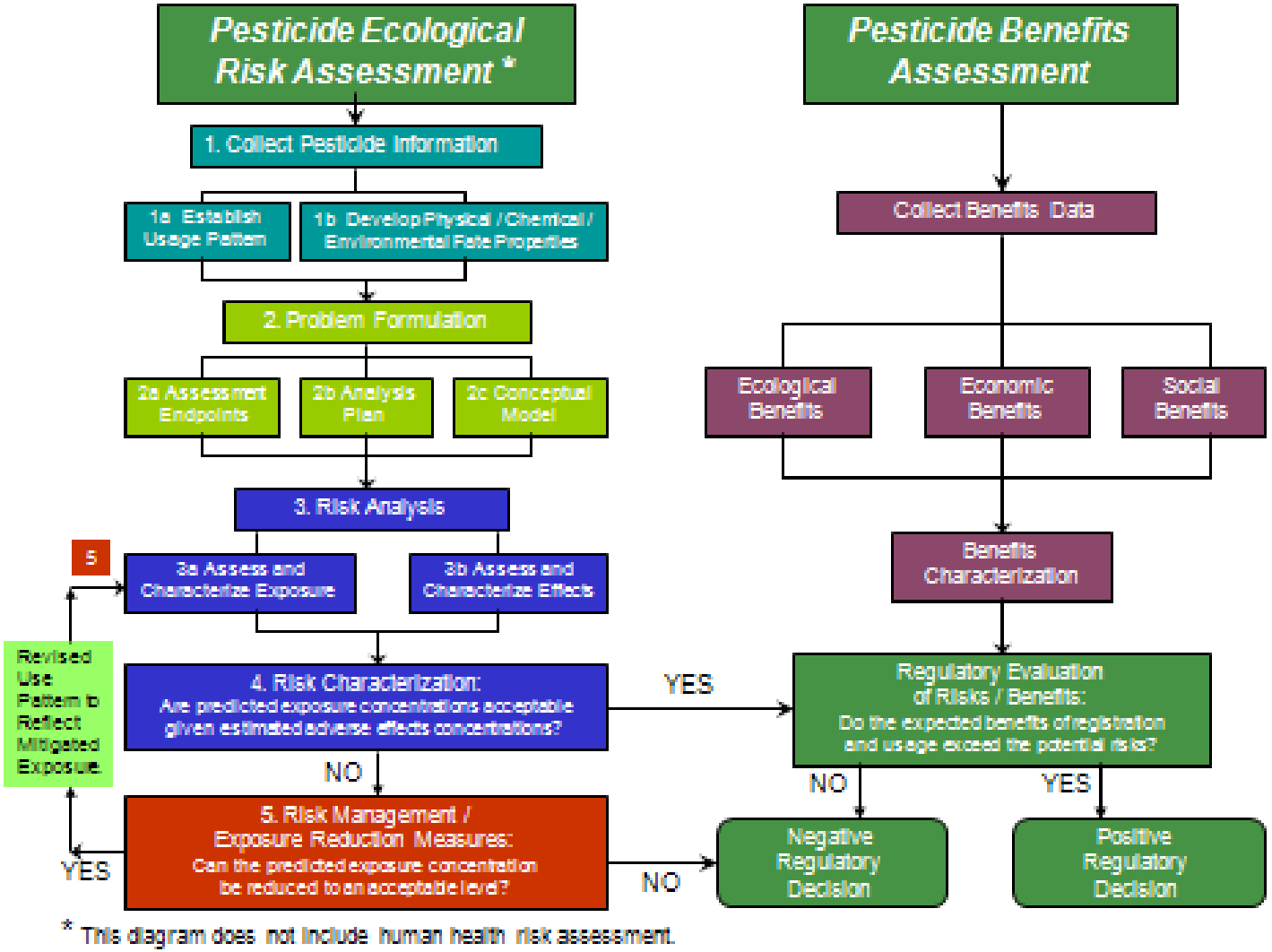
- Informs Pesticide Registration Decisions
- Informs Pesticide Risk Management Decisions
- Protects Wildlife
- Conserves Global Biodiversity
- Promotes Tourism

# Ecological Risk Assessment: How Does It Work?



- Estimates the Likelihood of Adverse Ecological Effects by Comparing Estimated Field Exposure to Measured Laboratory Toxic Effects Data
  - Effects = Toxicity, hazard
- May Be Combined With Human Health Risk Assessment & Pesticide Benefits Assessment for an Overall Pesticide Risk / Benefit Evaluation

# Ecological Risk Assessment Decision Diagram




* This diagram does not include human health risk assessment.

# Five-Steps of Ecological Risk Assessment

- Step 1: Data Collection
- Step 2: Problem Formulation
- Step 3: Risk Analysis
- Step 4: Risk Characterization
- Step 5: Risk Management

*Based on USEPA *Guidelines for Ecological Risk Assessment* and EU Directive 91/414/EEC

# Step #1: Pesticide Data Collection

- Develop and Assemble Data Needed for the Risk Assessment
  - Laboratory Physical / Chemical Data
  - Laboratory Ecological-Effects (Toxicity) Data
  - Laboratory and Field Environmental Fate and Exposure Data

# Types of Ecotoxicological Data

- The Most Data is Available for: Birds, Small Mammals, Fishes, Insects, Crustaceans, Mollusks, Vascular Plants, Algae
- The Fewest Data are Available for: Reptiles, Amphibians, Sponges, Protozoans, Fungi, Worms, Coelenterates & Plant Groups

# Number of Species Tested

- World Has Identified More than 1.3 Million Animal & Plant Species
- For New Chemicals, We Have Acute Toxicity Data for About 15 Species
- For Older Chemicals – We Have Data For About 50 Species
- For Herbicides, We Have Data for About 15 Plant Species

# Use of Indicator (Surrogate) Species

- 2 - 3 Species of Bird Represent 9,000 Species of Birds and 6,500 Species of Reptiles
- 2 – 3 Species of Fish Represent 22,000 Species of Fish and 4,000 Species of Amphibians
- 3 - 4 Invertebrate Species Indicate Sensitivity of 1 Million Species of Invertebrates
- 15 Plant Species Indicate Sensitivity of the Plant Kingdom
- 1 -2 Insect Species Represent Over 800,000 Insects

# *Web-ICE (Interspecies Correlation Estimation) Toxicity Estimation Tool for Ecological Risk Assessment*

Contact:
Sandy Raimondo, Deborah Vivian,
Jill Awkerman, and Mace Barron

USEPA/ORD/NHEERL/GED

5 December 2007

# *How well do ICE models work?*

## *Model uncertainty related to taxonomic distance*

**Aquatics in same order ~ 90% within 5-fold, 95% within 10-fold**

**Percentage of all datapoints in cross-validation category**

| Common level | Number datapoints | 5-fold | 10-fold | 50-fold | > 50 fold |
|---|---|---|---|---|---|
| genus (1) | 372 | 92 | 3 | 4 | 1 |
| family (2) | 1042 | 92 | 6 | 2 | 0 |
| order (3) | 280 | 89 | 6 | 4 | 1 |
| class (4) | 5622 | 79 | 9 | 8 | 4 |
| phylum (5) | 854 | 52 | 17 | 21 | 10 |
| kingdom (6) | 4524 | 50 | 16 | 22 | 12 |

# *How well do ICE models work?*

## *Model uncertainty related to taxonomic distance*

**Wildlife in same order ~ 90% within 5-fold, 97% within 10-fold**

**Percentage of all datapoints in cross-validation category**

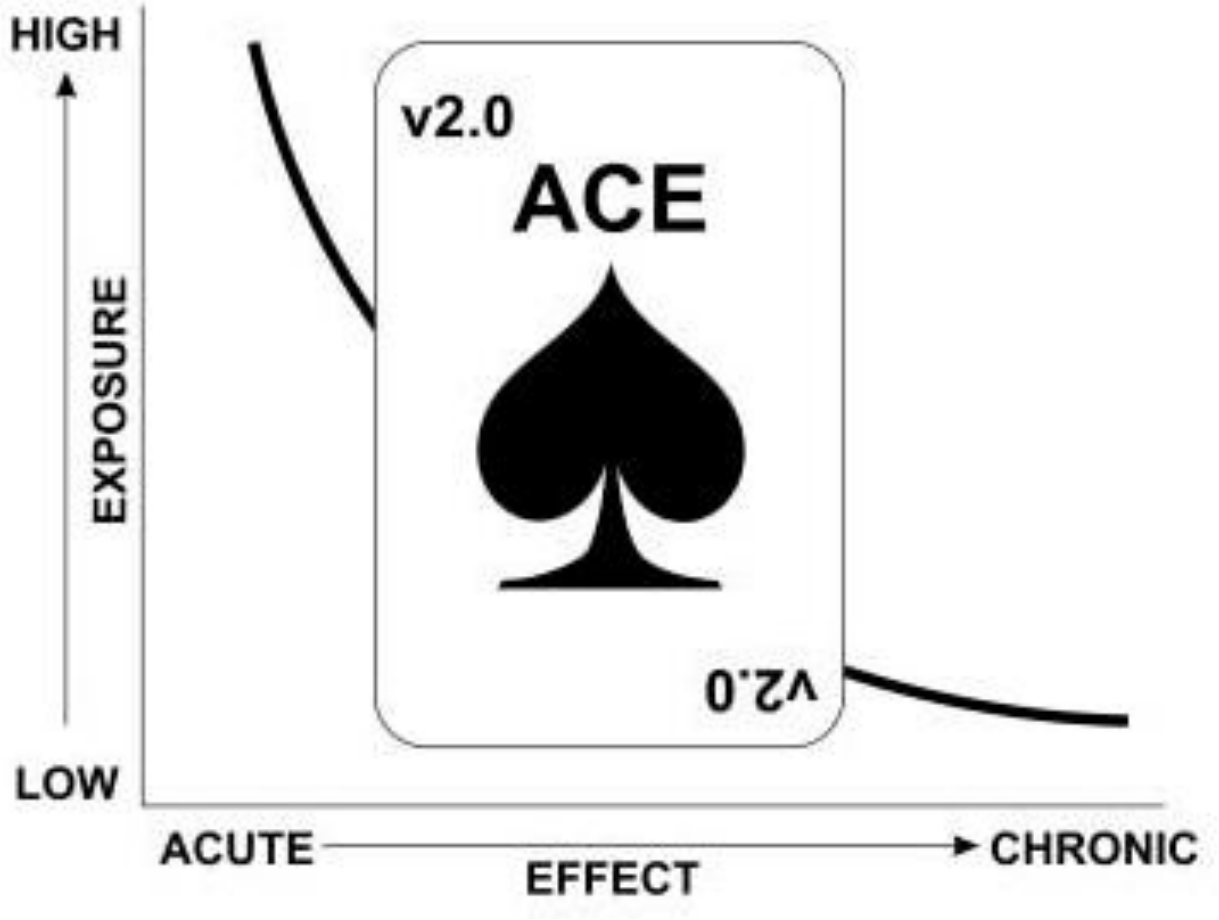
| Common level | Number datapoints | 5-fold | 10-fold | 50-fold | > 50 fold |
|---|---|---|---|---|---|
| genus (1) | 48 | 100 | 0 | 0 | 0 |
| family (2) | 1452 | 92 | 6 | 2 | 0 |
| order (3) | 2238 | 90 | 7 | 3 | 0.3 |
| class (4) | 5706 | 85 | 10 | 5 | 0.2 |
| phylum (5) | 2402 | 76 | 13 | 9 | 1.5 |

**Raimondo et al. 2003 Environmental Science and Technology (ES&T)**

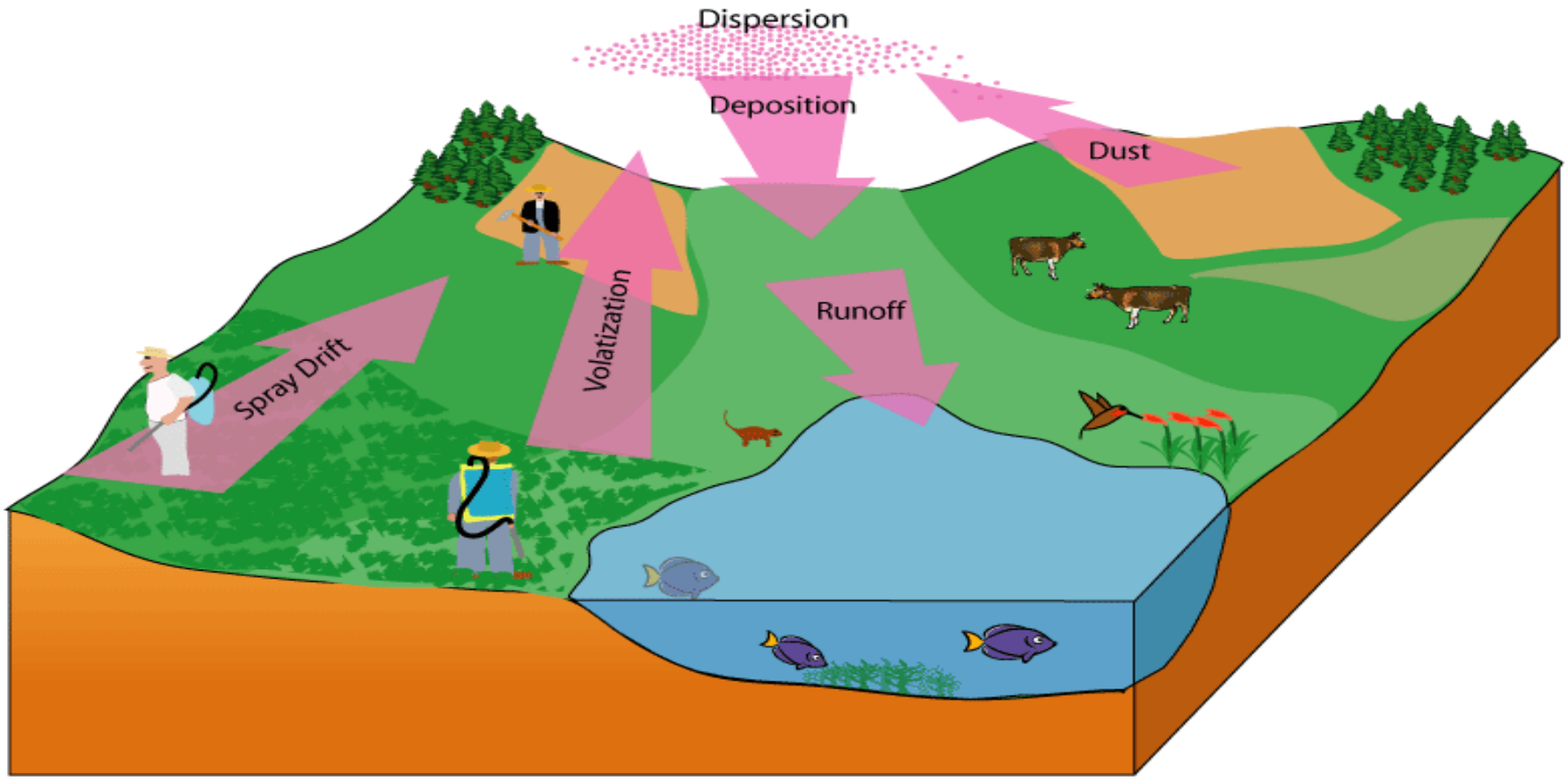
# Data For Chronic Risk Assessment

- 2 Species of Birds, 1-2 Species of Crustacea, and 1-2 Species of Fish Are Used to Represent Chronic or Sublethal Sensitivity of All Species in these Groups
- Limited Number of Chronic Endpoints Are Statistically Analyzed Under Controlled Laboratory Conditions

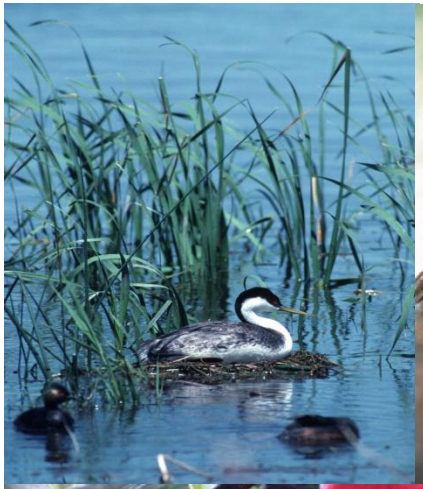
# Acute-to-Chronic Estimation (with Time - Concentration - Effect Models)

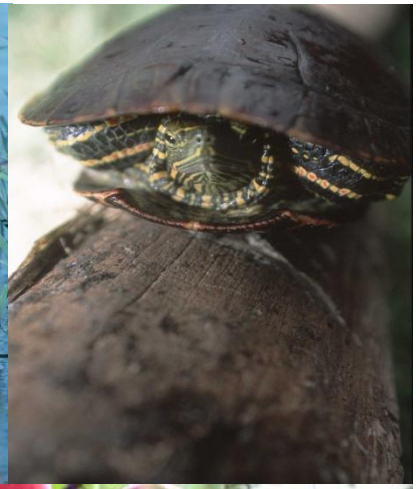


# Step #2: Problem Formulation: Every Pesticide is Different



# Step #2: Problem Formulation





- Generates and Evaluates Hypotheses About Reasons that Ecological Effects of Human Activities May Occur
- Evaluates the Nature of the Problem, Refines Objectives for the Analysis and Provides the Foundation for the Assessment.
- Develops a Plan For Analyzing Data and Characterizing Risk
- Responds to the Needs of the Risk Manager

# Step #3: Ecological Risk Analysis (1)

- Connects Problem Formulation Phase (Step 2) With the Risk Chacterization Phase (Step 4 )
- Examines the Relationships Between the Two Primary Components of Risk, *Exposure & Effects,* and Between Them and Ecosystem Characteristics
- Provides the Ingredients Necessary for Estimating Ecological Responses to Pesticides Under Exposure Conditions of Interest

# Step #3: Ecological Risk Analysis (2)


- Assessment Endpoints and Conceptual Models Developed During Problem Formulation Provide the Focus and Structure for the Analyses
- Develops Summary Profiles that Describe Exposure and the Relationship between the Pesticide (Stressor) and its Effects (Response)
- These Profiles Provide the Basis for Estimating and Characterizing Risk

# Aquatic Ecological Risk Analysis

- Explicitly Assesses Fish and Invertebrates
- Implicitly Assesses Amphibians, Molluscs, etc
- Assesses Both Freshwater Organisms and Salt Water / Estuarine Organisms
- Always Assesses Direct Effects
- Sometimes Also Assesses Indirect Effects (e.g. Fish Food, Habitat, Predators, etc)
- Most Difficult Type of Exposure Assessment – Due to Inherent Variability of Aquatic Habitat

# Terrestrial Ecological Risk Analysis

- Explicitly Assesses Birds and Mammals
- Implicitly Assesses Reptiles
- Always Assesses Direct Effects
- Sometimes Also Assesses Indirect Effects (e.g., Availability of Food, Habitat, Predators, etc)
- Much Easier than Aquatic Exposure Assessment

# Step #4: Ecological Risk Characterization

- Risk Assessors Use Results of the Analysis Phase (*Exposure and Effects*) to Develop an Estimate of the Risks Faced by Animal and Plant Populations and Communities
- Allows Risk Assessors to Clarify the Relationships Between Pesticide Effects and Ecological Communities and to Reach Conclusions Regarding the Occurrence of Exposure and the Potential to See Adverse Effects
- Assessor Identifies and Summarizes the Uncertainties, Assumptions and Qualifiers in the Risk Assessment
- Reports the Conclusions to Risk Managers to Provide Clear Information for Environmental Decision Making

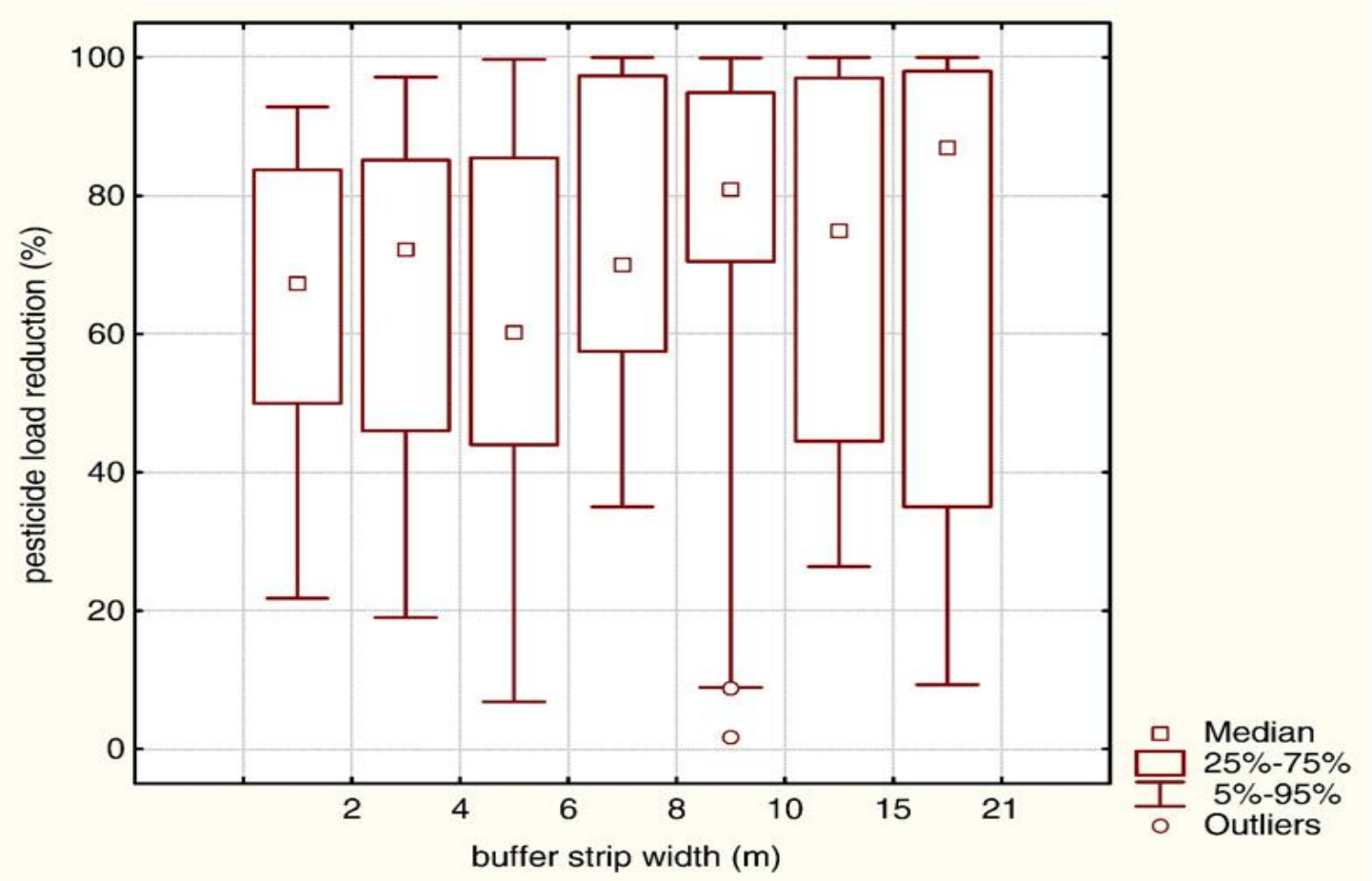
# Step #5: Ecological Risk Management: Possible Mitigation Measures

- Mitigation Measures Tailored to Local Conditions (e.g., Weather Limitations, Soil Type Limitations With Regard to Runoff, Sensitive Site Limitations)
- Pesticide Use Restrictions (Reduction In Application Rate and Number of Applications, Increased Time Between Applications, Acreage Limitation, Limits on Application Method, Requirement For Incorporation Into Soil)
- Separation Buffer Zones to Reduce Spray Drift to Vulnerable Sites
- Physical Barriers Such as Trees Along Waterways to Intercept Spray Drift
- Using No-tillage or Reduced Tillage Agriculture to Reduce Runoff and Soil Erosion

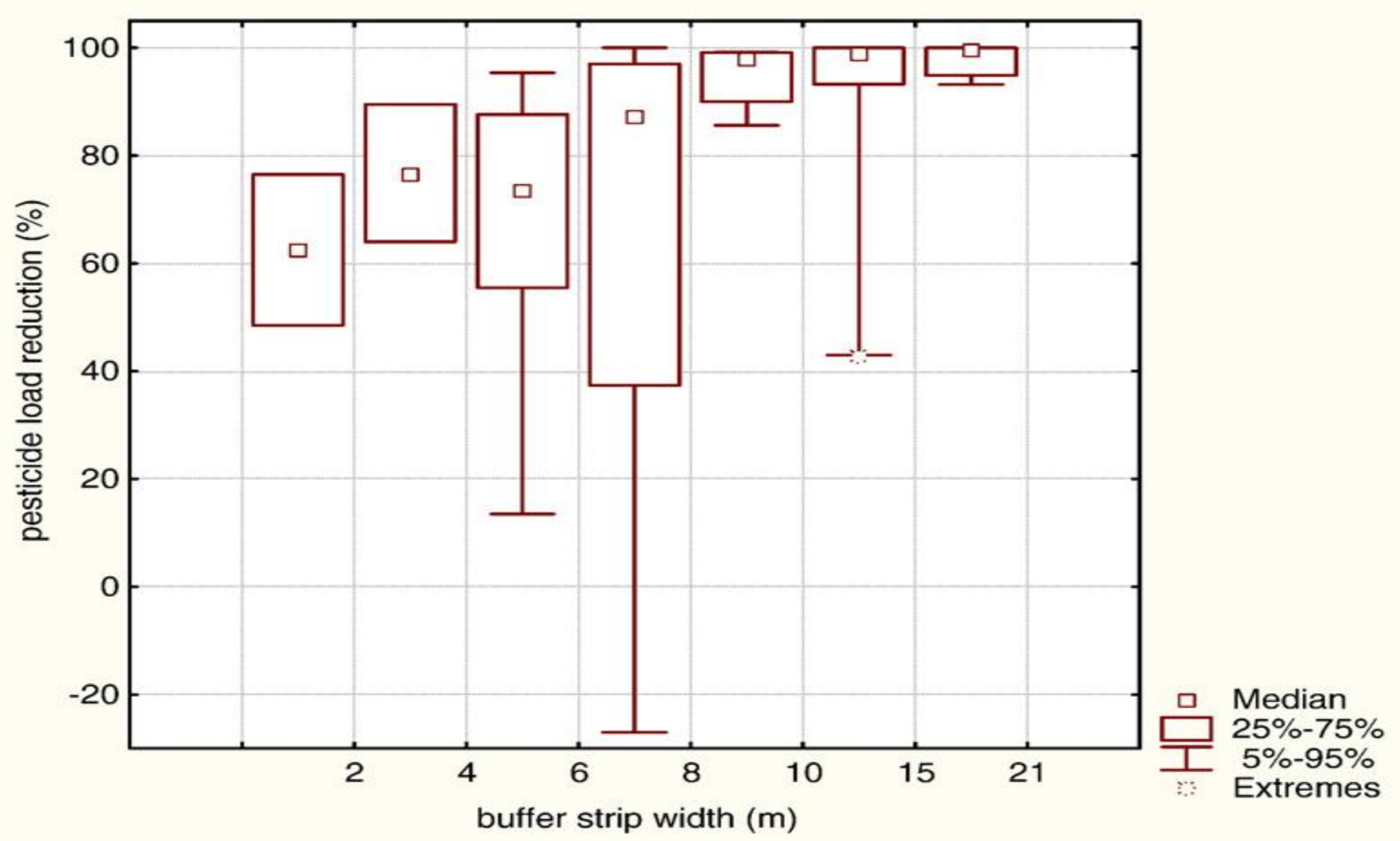
# Step #5: Ecological Risk Management: Possible Mitigation Measures

- Vegetated Buffer Zones to Reduce Offsite Runoff of Pesticide to Vulnerable Sites
- Use of Constructed Wetlands and Holding Ponds to Provide Time for the Pesticide to Degrade
- Application Restrictions (e.g., Method Type - Aerial Versus Ground, Field Tarps, Soil Compaction, Timing of Application)
- Equipment Cleaning and Maintenance Helps to Assure that the Target Application Rate Is the Rate that Is Actually Applied
- Restrictions on Locations at Which Equipment May Be Cleaned (Away From Waterways and Wells)
- Safe Disposal of Excess Product

# Load Reduction for Field Buffers: Dissolved Pesticide



# Load Reduction for Field Buffers: Adsorbed Pesticide



# Making Ecological Risk Assessment Work: Addressing Major Constraints

# Ecological Risk Assessment: Constraints Identified in Central American Workshop

- Need For Better Coordination Among Ministries Within the Country and Between other Countries in the Region
- Short Legal Time-Frame for Collecting Data and Conducting Ecological Risk Assessment
- Inadequate Resources (Funding, Trained Staff, Laboratory Facilities)

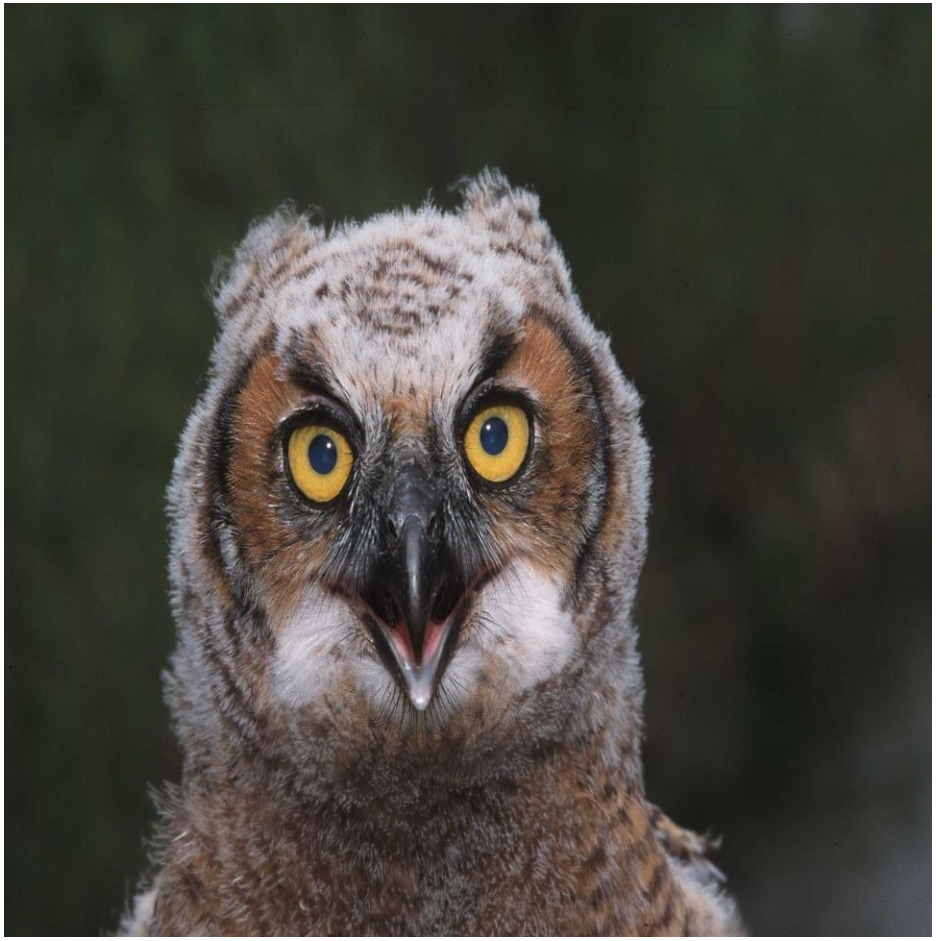
# Risk Assessment Constraints Identified by Latin American Regulators


- Limited Data on Local Non-Target Species Which May Need Protection
- Environment Fate and Toxicity Data that were Developed for Temperate Climates & Species
- Lack of Data For Exposure Assessment (Crops, Soil Properties, Water Resources, Weather History, etc)

# Risk Assessment is Scientifically Complex

- ERA Requires Many Scientific Disciplines
  - Agronomy, Botany, Entomology, Ecology, Bacteriology, Toxicology, Public Health, Chemistry, Hydrology, Environmental & Agricultural Engineering, Crop Production, Farm Management, Economics, Statistics, Geology, Zoology, etc.
- ERA Requires Strong Management & Coordination Skills

# Development of Ecological Risk Assessment – Risk Management Training Module (eVALUATE)



- OECD Working Group on Pesticides (WGP): International Pesticide Assessment Consultation
  - Held in Washington, DC in October 1998
  - Hosted by the USEPA Office of Pesticide Programs and the National Chemicals Inspectorate of Sweden
  - OECD, Non-OECD, NGOs: UN Organizations, Pesticide Industry
- Requests by Latin American Countries to USEPA/OPP for Training in Risk Assessment Methods

# Funding and Technical Support for eVALUATE

- Partially Provided by USEPA Field and External Affairs Division
- Partially Provided by IUPAC Division of Chemistry and the Environment
- Technical Support Provided by OPP EFED, Members of IUPAC Division of Chemistry and Environment & Industry Scientists
- Cooperation & Support from:
  - Joint International Atomic Energy Agency-Food and Agriculture Organization (IAEA-FAO) Pesticide Program
  - International Food Contaminant and Residue Information System (INFOCRIS) Pesticide “Distance Learning for Capacity-Building” (e-Learning) Website

# Original OECD WGP Recommendations

- Provide Access to Examples of Completed Risk Assessments
- Encourage Harmonization, Work-sharing & Membership in Regional Groups
- Create a “Layman’s Guide” to the OECD Monograph Guidance Documents
- Standardize Definitions for Risk Assessment Vocabulary and Processes
- Identify Useful Sites on the World Wide Web

# OECD WGP Recommendations

- Assist in Technology Transfer of Risk Assessment Methods & Tools
  - Provide Access to Tools for Estimating Pesticide Exposure
  - Provide Access to Tools for Estimating Pesticide Toxicity
- Encourage Participation in International Groups and Treaties (IFCS, PIC, POPS, IPCS, Montreal Protocol)

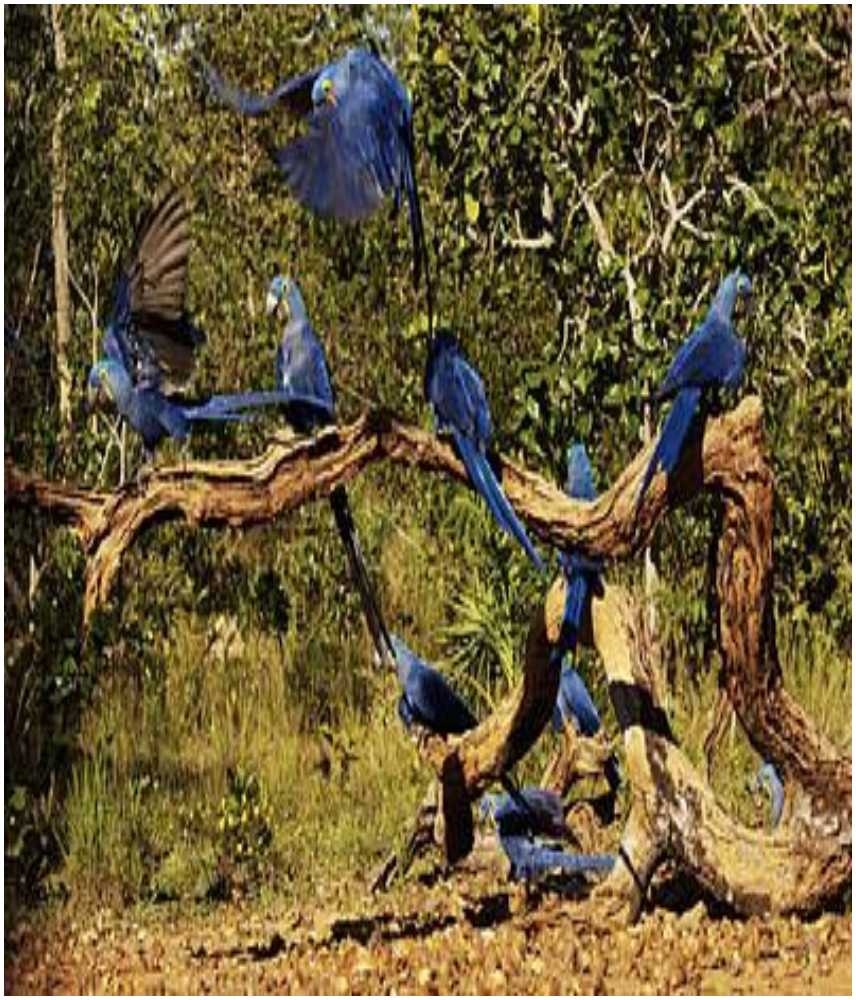
# OECD WGP Recommendations


- OECD Should: Consider Ways in Which Data Developed for Temperate Climates Could be Adapted to Meet the Needs of Developing Countries with Arid & Tropical Climates
- Pesticide Industry Should:
  - Consider Ways to Facilitate the Flow of Information from Agencies in Developed Countries to those in Developing Countries
  - Assist and Encourage National Regulatory Agencies in the Development and Adoption of a Common Data Submission Format

# Benefits of Work-sharing and of Harmonized Methods and Testing

- Work-sharing Among Countries
- Harmonization
  - Common Test Guidelines
  - Joint Data Development
  - Common Assessment Methods
- Joint Data Review
  - Reduces Costs
  - Increases Range of Expertise Available
  - Saves Time

# Regional Harmonized Assessment Groups



- European Union (EU)
- North American Free Trade Agreement (NAFTA) Countries
- Organizational For Economic Cooperation And Development (OECD) Countries
- Andean Community Countries
- Central American Countries:
  - Central American Free Trade Agreement (CAFTA)
  - Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA)
- West African Countries: Comité Sahelien Des Pesticides (CSP) – the Regional Registration Authority
- Southern African Development Community (SADC) Countries
- MERCOSUR Countries (possible)

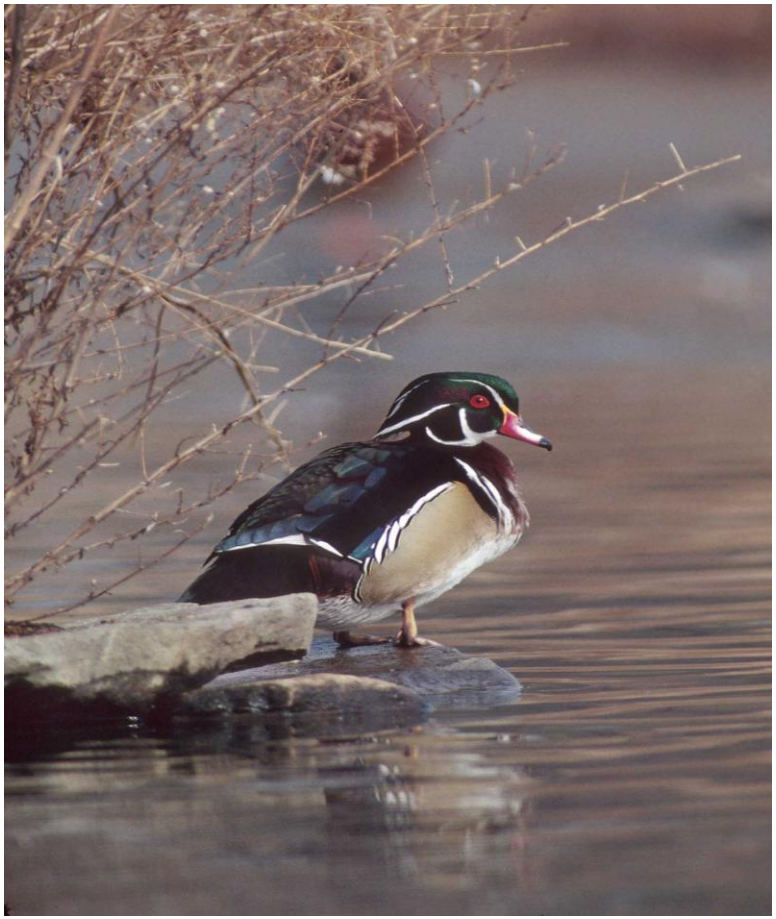
# Components of e-VALUATE Pesticide Risk Assessment & Training Module


- Step-by-Step Guidance
- Risk Assessment Process Diagram
- Risk Management Guidance
- Glossary of Terms & Process Descriptions
- Environmental Fate and Toxicity Databases
- Training Materials
- Exposure Models
- Internet Linkages

# User-friendly, Harmonized Aquatic and Terrestrial Exposure Models

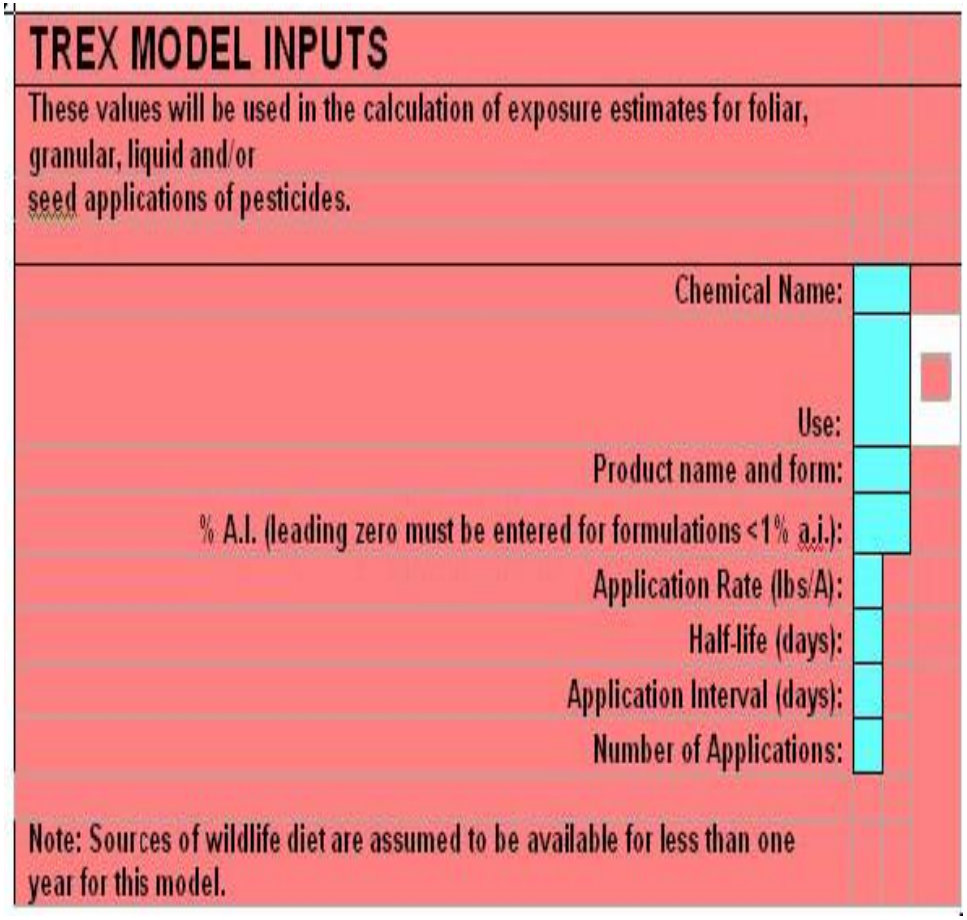
- EXPRESS (EXAMS - PRZM Exposure Simulation Shell): User-friendly, Input/Output Shell to Estimate Pesticide Exposure to Aquatic Wildlife Using More Complex, Sophisticated Models
- T-REX (Terrestrial Residue Exposure) Model Is a More Complex, Spreadsheet-based Estimator of Terrestrial Ecological Risk Also Based on Potential Pesticide Residues on Avian and Mammalian Food Items Using the Fletcher-Kenaga (UTAB) Data Base, and
- RICE Models: Pesticide Environmental Fate and Transport, Water Quality Model that Estimates Pesticide Concentrations Within and Down-steam From Single or Multiple Rice Paddies.

# EXPRESS (EXAMS - PRZM Exposure Simulation Shell)



- EXPRESS (EXAMS - PRZM Exposure Simulation Shell) Is a User-friendly, Input/Output Shell to Estimate Pesticide Exposure to Aquatic Wildlife Using Much More Complex and Sophisticated Models
- Simulations Using the Pesticide Root Zone Model (PRZM) and Exposure Analysis Modeling System (EXAMS) Are Used For a “Refined” Estimation of Pesticide Concentrations In Surface Waters Used as Drinking Water Sources and for Aquatic Ecosystem Exposure Assessments.

# T-REX (Terrestrial-Residue EXposure) Model for Avian / Mammalian Exposure Assessment




- T-REX (Terrestrial Residue Exposure) Model Is a Spreadsheet-based Estimator of Terrestrial Ecological Risk
- Not Site or Region (or Country) – specific
- Based on Potential Pesticide Residues on Avian - Mammalian Food Items Using the Fletcher-Kenaga Database

# Additional Work on eVALUATE Still Needed

- Complete Translation into Spanish, Portuguese and other Languages
- Develop HTML Versions for the Internet
- Develop Crop-specific EXPRESS Scenarios
- Coordinate Module, Models, Manuals, and Materials with other Organizations
- Conduct National and Regional Training Workshops In Use of the Module