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WERF
Water Environment Research Foundation
Collaboration. Innovation. Results.

Diagnostic Tools to Evaluate Impacts of Trace Organic Compounds on Aquatic Populations and Communities

Tt Project Team

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WERF Research Challenge

- Understand, manage, and communicate perceived and potential risks of trace organic compounds (TOrCs)
- Focus on TOrCs in surface waters from point and non-point sources
- Coordinate with other organizations

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Trace Organic Compounds - TOrCs

- ✓ Organic compounds known or suspected to be released to the aquatic environment
- ✓ Not commonly regulated or monitored
- ✓ Potential risk to ecological health relatively unknown

Research Objectives

- Develop and apply a procedure to prioritize TOrCs
- Develop and test diagnostic tools to identify TOrCs by source type
- Develop a relational database of TOrC exposure data
- Develop a Collaboration Plan for fostering partnerships among stakeholders in Phase 2

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Project Focus

- Organic contaminants of emerging concern
- Surface water only
- Ecological, not human health
- Wastewater-influenced sites
- Effects on aquatic populations and communities

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TOrC Prioritization Approach

Compile:

- TOrC occurrence data
- TOrC fate information (ECOSAR, PBT Profiler)
- Predicted toxicity and endocrine activity thresholds (ECOSAR, PBT Profiler, EU, FDA)

TOrC Prioritization Approach

Prioritized TOrCs based on either:

1) Maximum observed concentration vs. conservative effect thresholds
2) Max vs. thresholds + persistence and bioaccumulation potential
3) PBT – not occurrence-based

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Occurrence Data

- > 100 studies examined; 70 studies used
- Information from > 700 sites
- Over 500 TOrCs, including 48 high risk, high production volume TOrCs (Muir, et al 2009) with no occurrence information
- > 30 monitoring organizations represented

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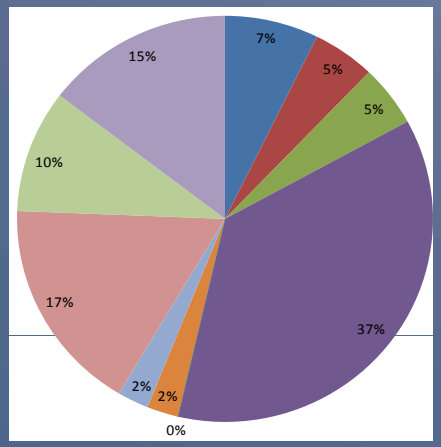
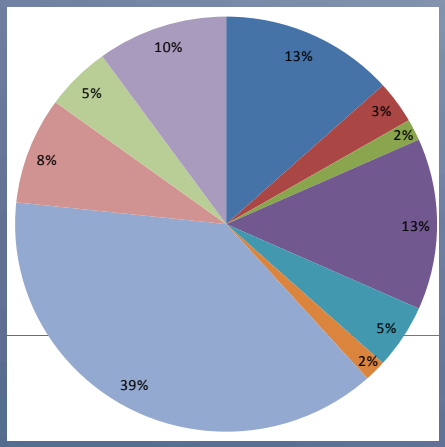
Types of High Priority TOrCs by Approach

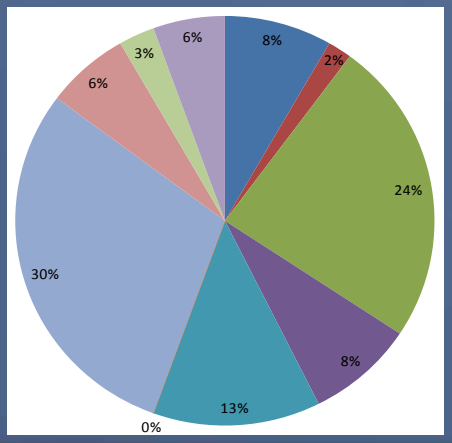
Risk



Risk + P + B



P + B + T



- Deodorizer/Fragrance
- Flame Retardant
- Industrial Chemical
- Natural Hormone/Steroid
- PAH
- Personal Care Product
- Pesticide
- Pharmaceutical
- Plasticizer
- Surfactant

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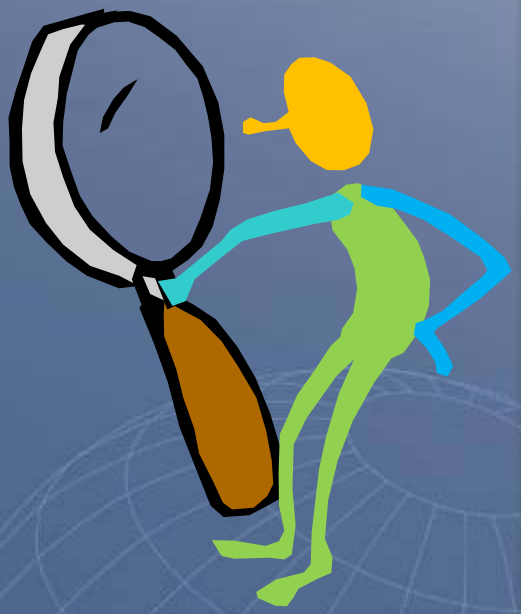
High priority TOrCs that are monitored infrequently

- 3-methylcholanthrene
- 4-nonylphenol diethoxycarboxylate
- 4-nonylphenol monoethoxycarboxylate
- Acetyl cedrene
- Benfluralin
- Celestolide (ADBI)
- Clotrimazole
- Di-N-octyl phthalate
- Musk xylene
- Novobiocin
- Oryzalin
- OTNE



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Results: Risk-based Prioritization Approach

- Few pharmaceuticals ranked as high priority based on either predicted toxicity or endocrine activity thresholds
  - Exceptions are steroids and hormones

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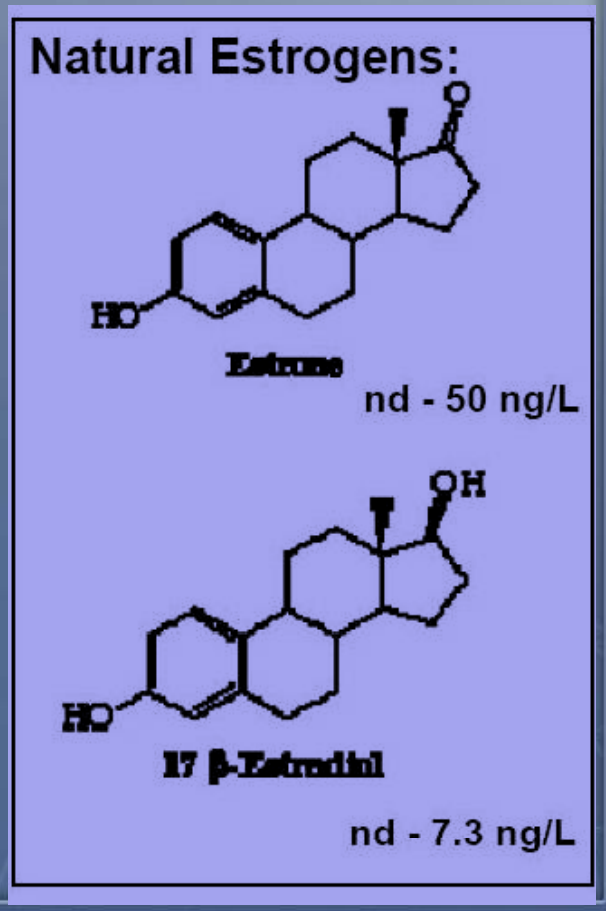
Results: Risk-based Prioritization Approach

Most sensitive endpoint is predicted chronic toxicity rather than estrogenic activity for most high priority TOrCs

- Exceptions are the few hormones



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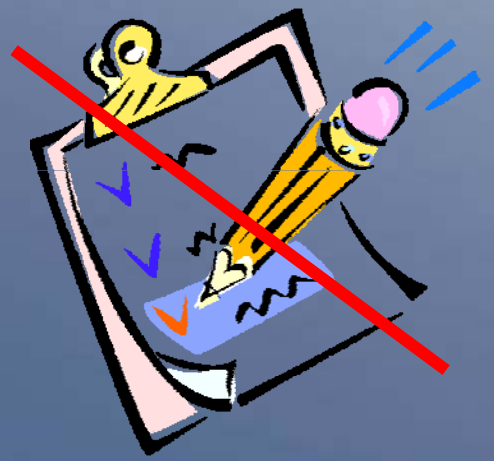
Results: Risk-based Prioritization Approach

- Lists of high priority TOrCs should **not** be taken as monitoring requirements or chemicals for regulation



- Prioritization approaches should help utilities and others organize and manage screening of TOrCs.

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DIAGNOSTIC SCREENING TOOL DEVELOPMENT

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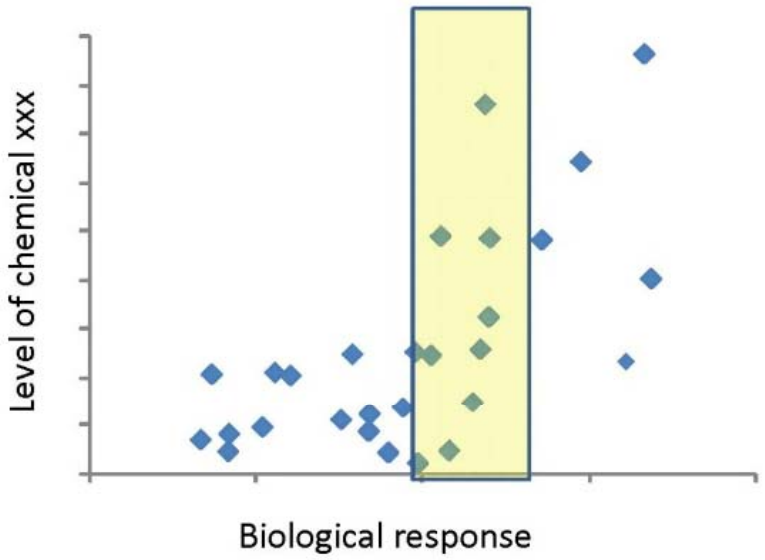
Challenges

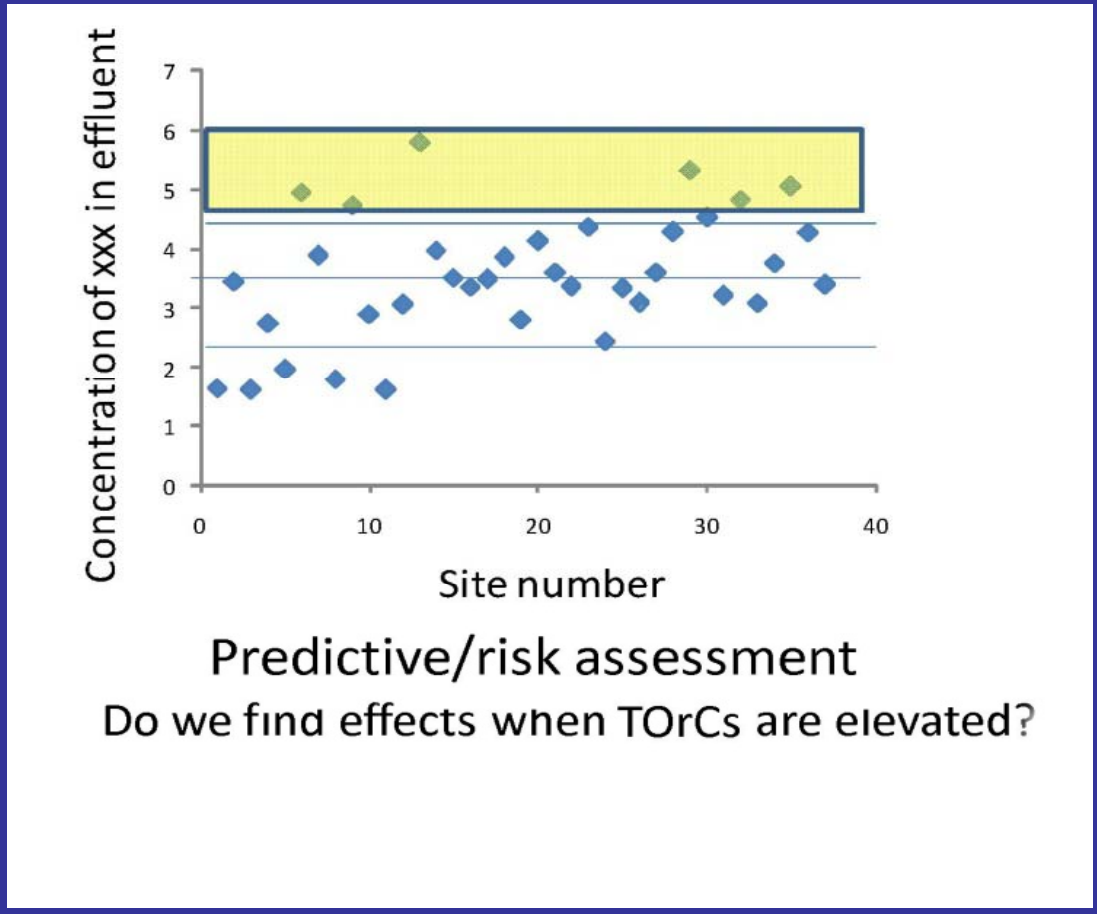
- TOrCs often co-occur with less subtle stressors (e.g., habitat modification, nutrients)
- Link between EDC effects on individual organisms and population / community level effects not clear
- Mode of action unknown for many TOrCs

Under what types of site conditions do TOrCs pose a risk to aquatic populations and communities?



Under what types of conditions do TOrCs pose a risk?

Do TOrCs measured in effluent pose a risk to aquatic populations and communities?



Two General Approaches

- Screening assessment:
  - Develop relationships between certain types of sources (e.g., POTW effluent) and biological effects
  - Infer TOrC effect using exposure models
- Diagnostic risk assessment:
  - Evaluate high priority TOrCs first
  - Use causal analysis tools (e.g., CADDIS)
- Both approaches work together.

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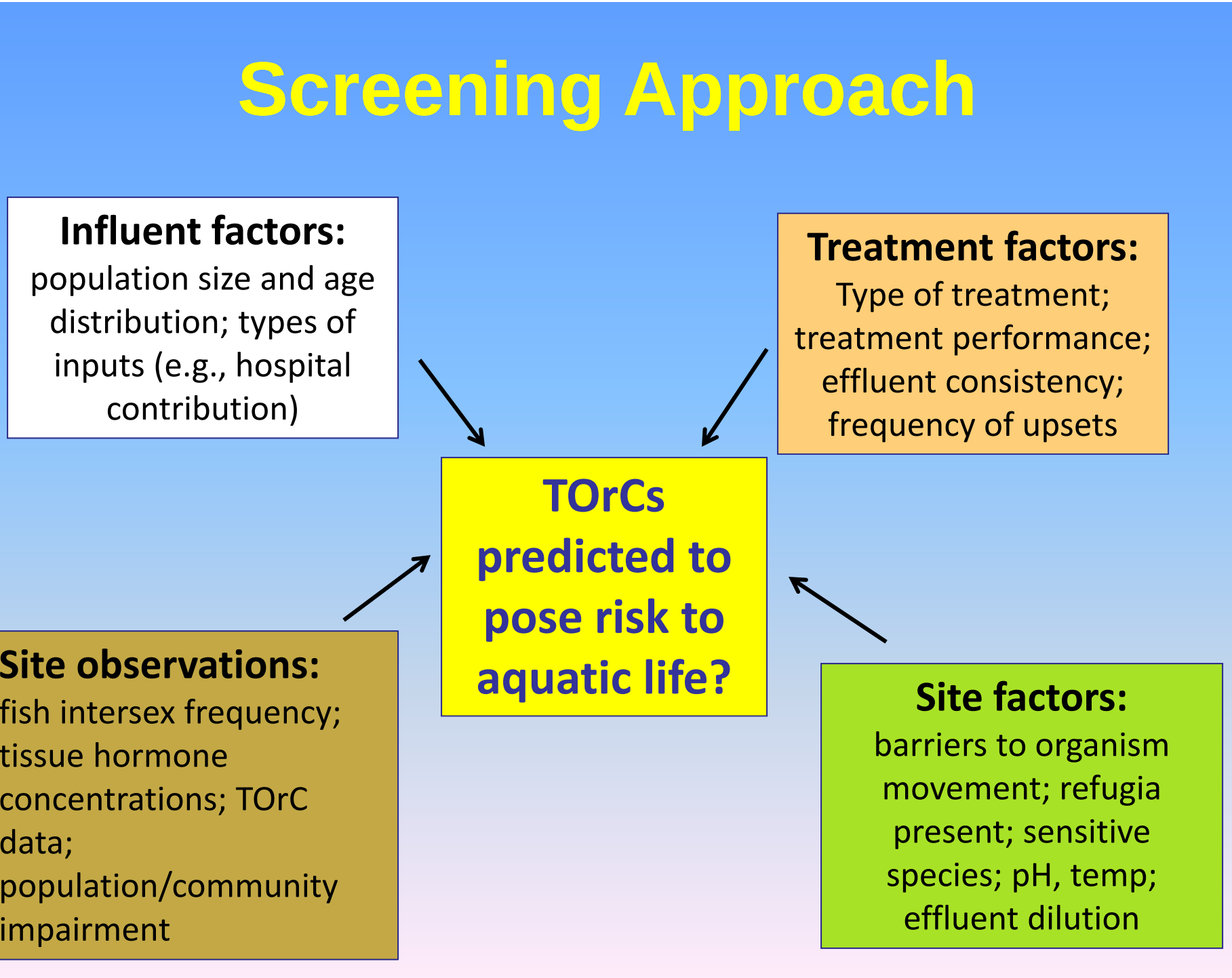
Screening Approach



DIAGNOSTIC RISK ASSESSMENT

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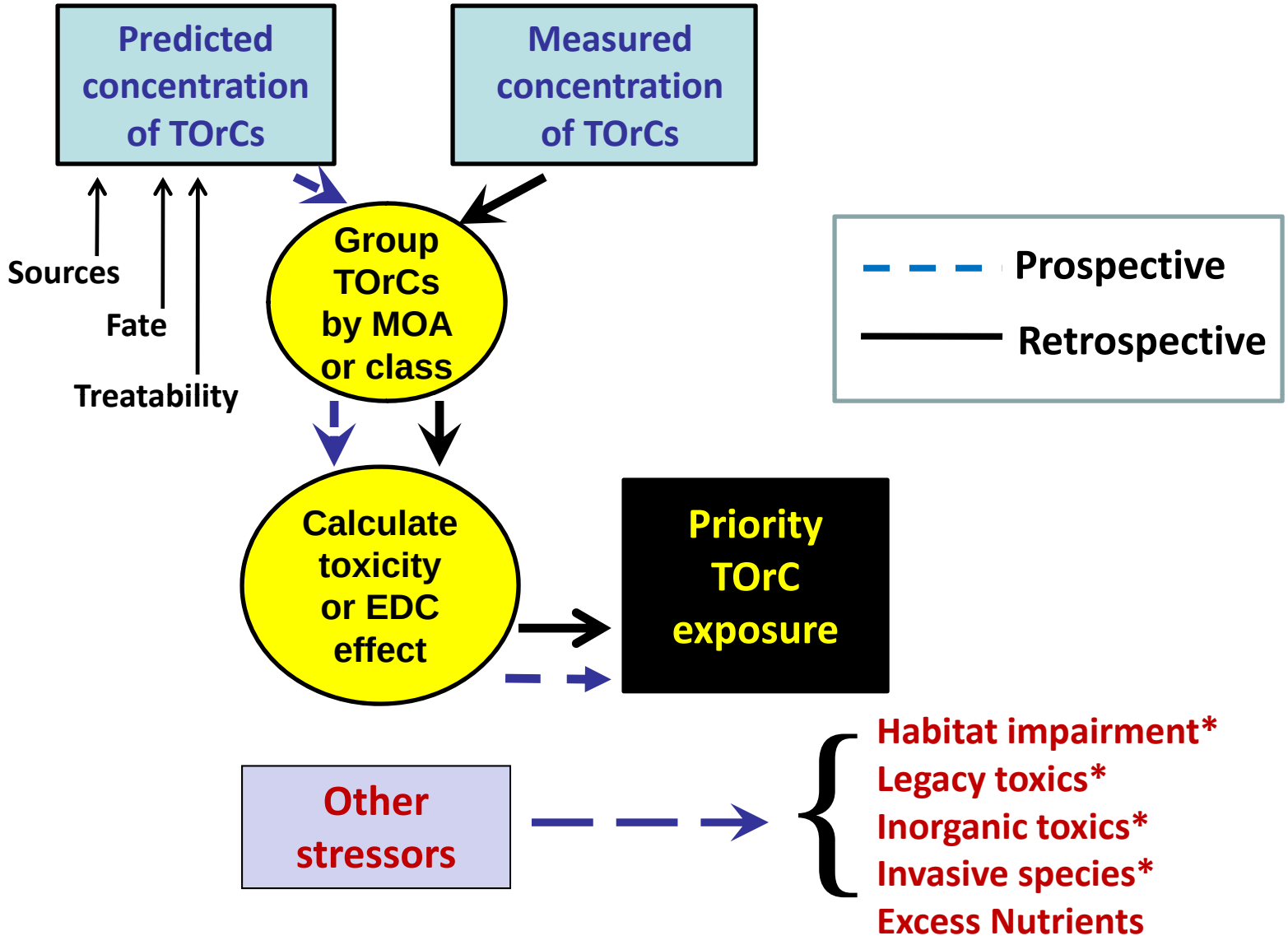
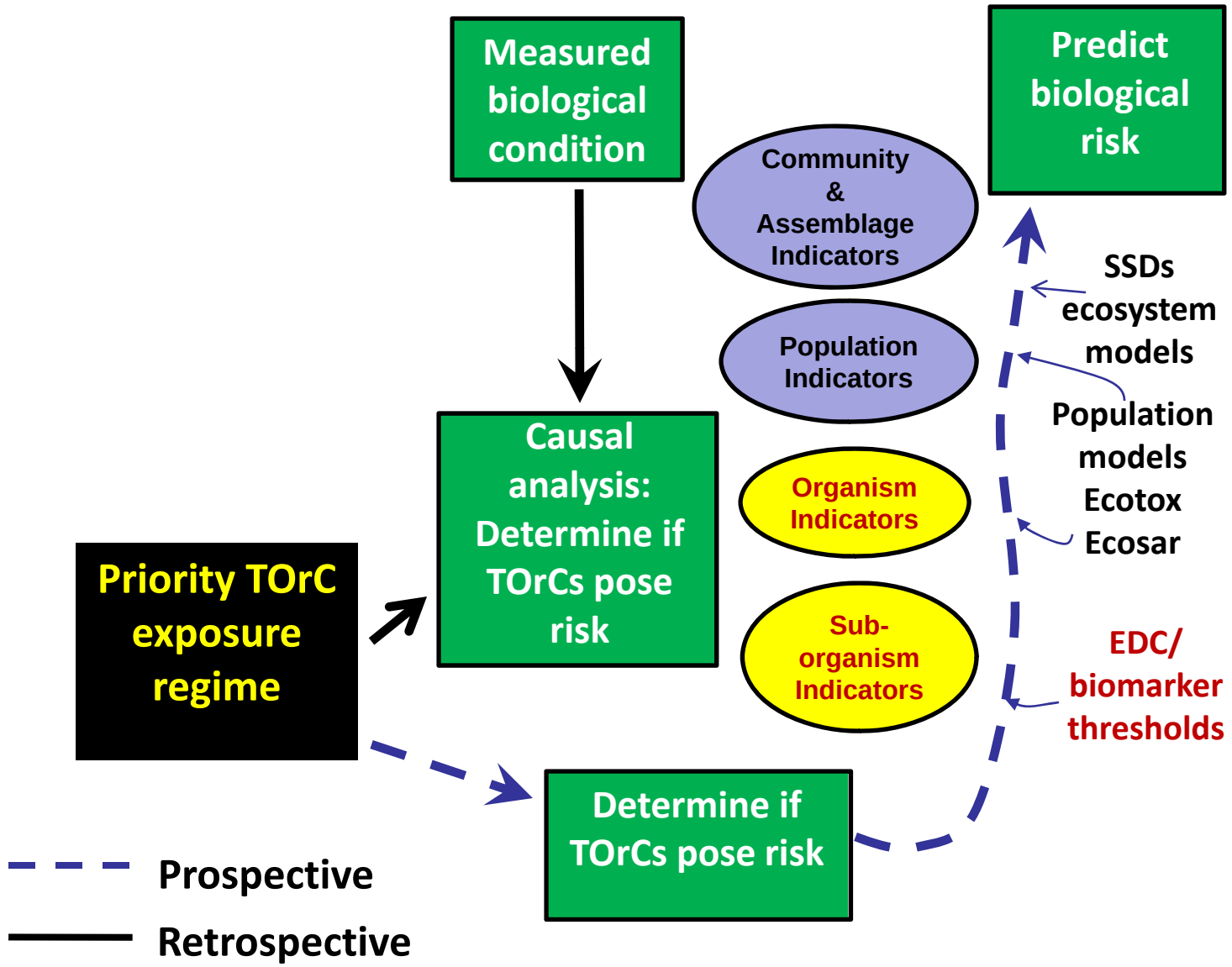
EXPOSURE



* Not readily predicted – usually must be measured at site

EFFECTS


Measured biological condition
Predict biological risk
Community & Assemblage Indicators
Population Indicators
Organism Indicators
Sub-organism Indicators
SSDs ecosystem models
Population models
Ecotox
Ecosar
EDC/ biomarker thresholds
Causal analysis: Determine if TOrCs pose risk
Priority TOrC exposure regime
Determine if TOrCs pose risk
Prospective
Retrospective

Coordination and Collaboration are Key

- California water re-use CEC prioritization
- Int'l Joint Commission of Great Lakes Survey
- Florida micro-constituent evaluations
- USGS-NAWQA 3rd decade CEC prioritization
- Canadian Water Network CEC prioritization
- EPA – POTW surveys; fish tissue surveys
- EU EDC prioritization

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Next Steps

- Evaluate example case studies using screening and diagnostic framework
- Develop hypotheses that should be tested in Phase 2
- Build collaborations & partnerships for Phase 2