UP3 Project

Urban Pesticide Use Patterns – Pesticides of Concern for Surface Water Quality

Kelly D. Moran, Ph.D.
TDC Environmental, LLC

UP3 Project

Urban Pesticide Pollution Prevention Project

- Manager: San Francisco Estuary Project
- Funding: State Water Board, Municipalities
- Goal: Prevent surface water toxicity from urban pesticide use
- Activities:
  - Science, regulatory support for water quality agencies
  - Urban Pesticides Committee (teleconference)
  - E-mail listserver (open to all)
  - Web site www.up3project.org

Acknowledgements

- Data and Peer Review
  - DPR
  - California Water Boards
  - Tri-TAC and its members (POTWs)
  - CASQA and its members (Urban Runoff)
  - University of California
  - USGS
  - U.S. EPA Region 9
  - Many other individuals and organizations

Pesticides Aren't Emerging – They Are Here

- >80% of Urban Streams Exceeded Benchmarks in USGS NAWQA Monitoring
  - Insecticides more common, at higher concentrations in urban areas than in ag areas
- Record of Clean Water Act Violations
  - DDT & other OCs, OPs (diazinon), Pyrethroids
  - POTW compliance (Copper, Tributyltin, OPs)
- Single-Pesticide Regulatory Approach Causes Continual Market Shifts

Urban Context Differs from Agriculture

- ≥ Half of CA Pesticide Use Is Non-Ag
- Different use patterns
  - Applications on pavement
  - Sewer discharges
- Different pesticides
  - Some problem pesticides primarily used in urban areas
    - Bifenthrin
  - Biocides (antimicrobials) almost 100% urban
    - Triclosan, pentachlorophenol, creosote, pool & spa biocides

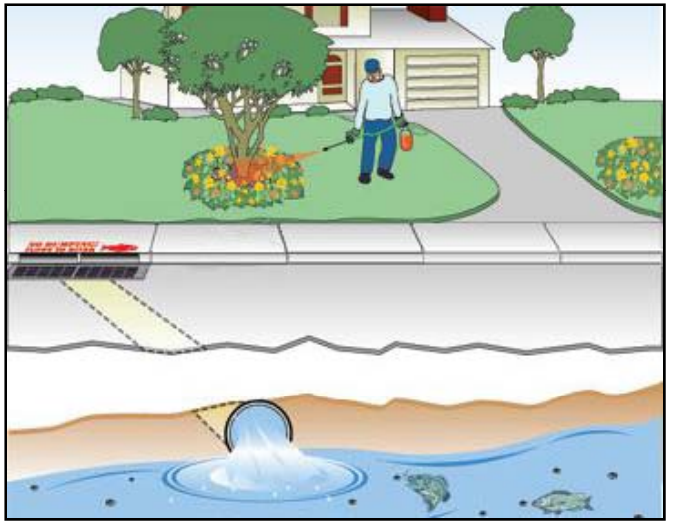


Figure from UC Statewide IPM Project

Major Use Patterns: In Water

Algaecides

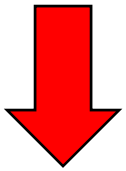
Marine Antifouling Coatings

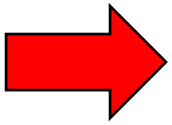
Priority In-Water Use Pattern: Marine Antifouling Paint

- Old: Tributyltin
- Current: Copper
- Coming: Irgarol, Zinc Pyrithione

Copper Pyrithione

Major Use Patterns: POTW Discharge





Priority POTW Discharges

- Insecticides
  - Both deliberate & incidental discharges
  - Usually caught in reqd. toxicity monitoring
- Biocides – Largely Unstudied
  - Past example: Tributyltin
  - Triclosan
  - Pentachlorophenol/ dioxins

Photo courtesy WaterCare Services, Ltd.

Major Use Patterns: Outdoors

Priority Outdoor Use Patterns

- Outdoor Structural Insecticides
  - Water quality problems from every popular insecticide used since 1960s
    - Old: DDT, Chlordane, Diazinon, Chlorpyrifos
    - Current: Pyrethroids
    - Coming: Fipronil (maybe also Carbaryl, Malathion)
  - Most load – Runoff from storm events
- Biocides – Largely Unstudied
  - Pentachlorophenol/dioxins?
  - Swimming Pools (PHMB) – Creeks

California Drainage Design Enhances Pollutant Transport

Typical California urban stormwater conveyance system – Street gutter

Water & pollutants efficiently moved to creeks

Alternative stormwater conveyance system example – Vegetated swale

Slower flow & infiltration reduces pollutant discharge (e.g., TSS removal about 80%)

TSS Data Source: Compilation of TSS removal data in CASQA (2003). *California Stormwater BMP Handbook New Development and Redevelopment*. January.

Phase Out Reduced Diazinon Levels in Chollas Creek (San Diego)

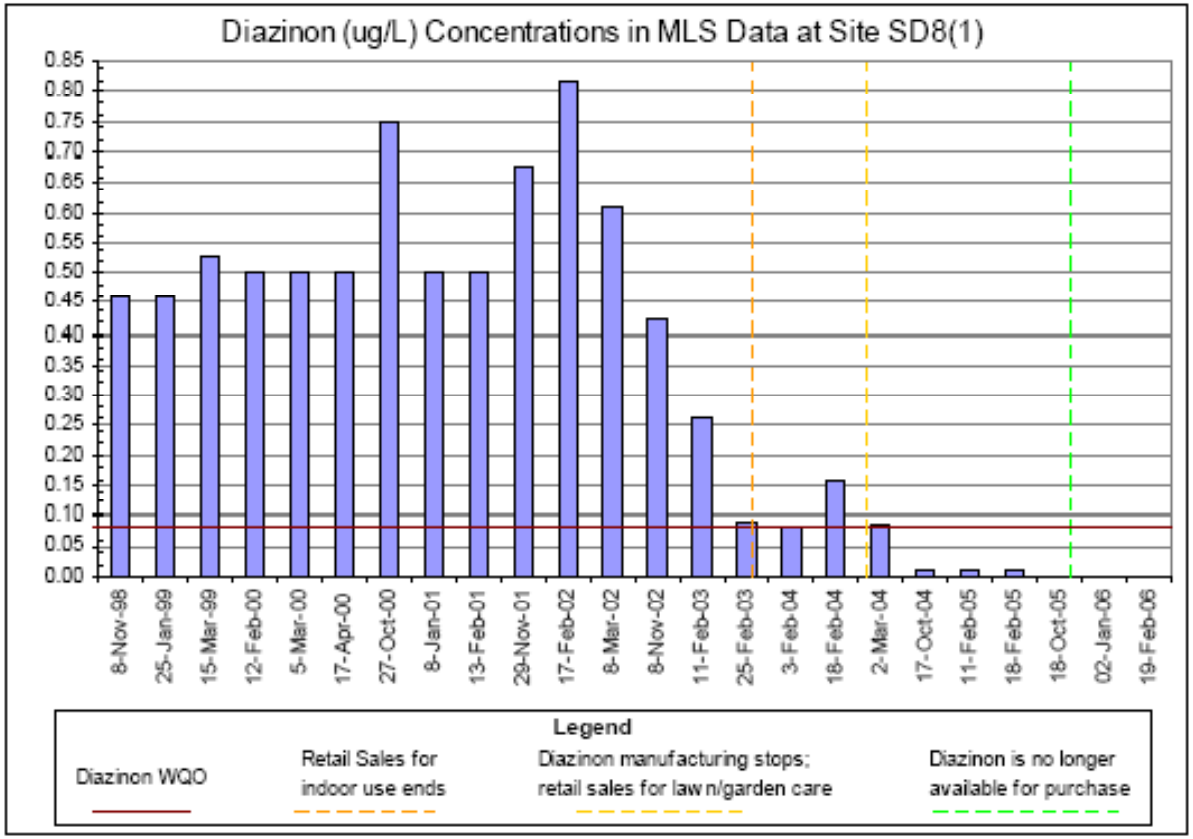


Figure 1-2. Diazinon Concentrations at Chollas Creek MLS Site SD8(1)

Source: City of San Diego, Chollas Creek TMDL Source Loading, Best Management Practices, and Monitoring Strategy Assessment, prepared by Weston Solutions, September 2006.

Pyrethroids Causing Toxicity in Urban Sediments Statewide

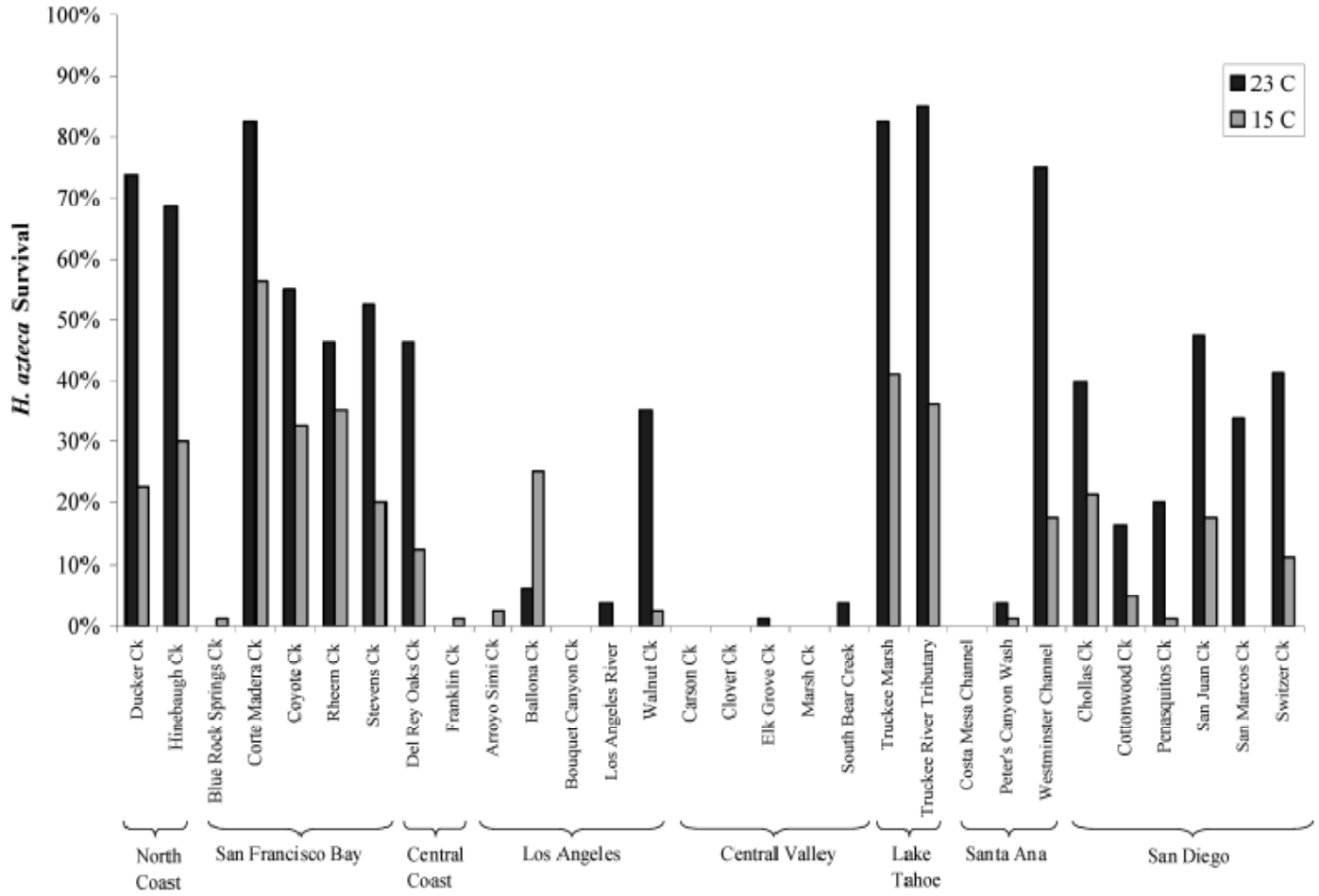


FIGURE 2. ***H. azteca*** **percent survival from sediment toxicity tests conducted at 23C and 15C with sediments from each urban creek.**

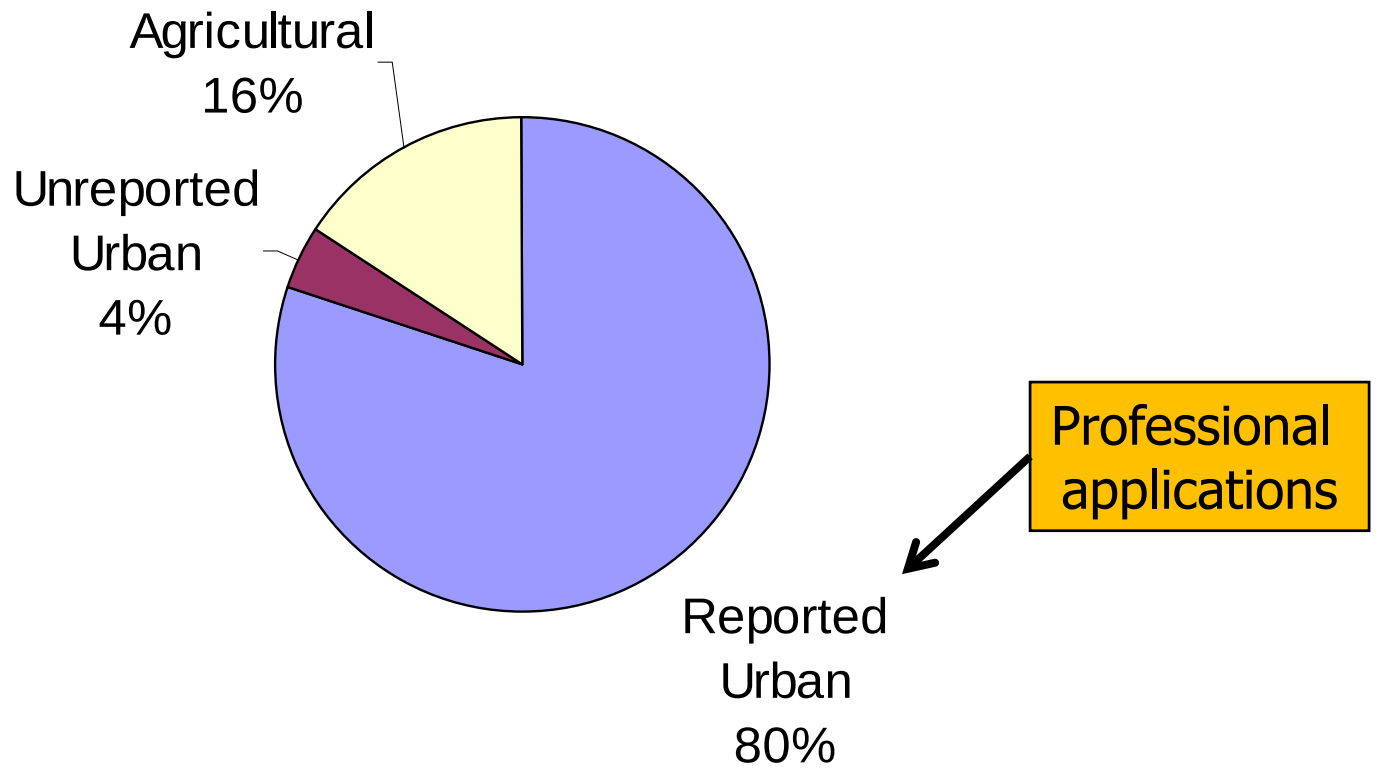
Source: Holmes et al, ES&T, 2008

Urban Surface Water Toxicity

- Pyrethroids causing toxicity in sediments
  - Severe, widespread: creeks, ag drains, few rivers
  - Linked to urban runoff, ag discharge
  - Multiple pyrethroids (bifenthrin>others)
  - Toxicity linked to OC concentration
- Pyrethroids also causing toxicity in water
  - During storm events - SD & Riverside Counties
  - Toxicity to *Hyalella azteca*
    - In water with clean sand substrate
  - *Also occurring in Delta (from Ag use)?*
    - *POD work (particularly work of Inge Werner, UC Davis)*

Most Pyrethroid Use Is by Professional Applicators

California 2004-2005 Use of Urban Priority Pyrethroids
(Permethrin Equivalents)



Source: California DPR Pesticide use reporting data, conversion to permethrin equivalents based on aquatic toxicity (see UP3 Project reports).
Note: Data accuracy warrants only one significant figure. Additional digits provided to simplify category tracking.

Myth: Current Pesticides Are Being Monitored

- Most pesticides aren't monitored
- Analytical methods to detect pesticides at environmentally relevant concentrations are not available for most current-use pesticides
- Common "wisdom" has no basis
  - No measurement = No problem **Not True**!
  - No detection = No problem **Not True**!

Monitoring Pesticides is Important

- Identify Current Problems
- Evaluate Trends
  - Potential future problems
- Inform Regulatory Processes
  - Data needed for modeling linkage between urban use patterns & surface water
  - Information will improve pesticide regulators' ability to prevent problems

Monitoring Recommendations

- Toxicity Testing Efficient
  - Standard U.S. EPA Office of Water species
    - Most sensitive to current problem pesticides:
      - Fresh water & sediment — *Hyalella azteca*
      - Salt Water — *Americamysis bahia*
  - Water column & sediments
  - Pesticides are not the only cause of toxicity
  - Temperature may be important

Monitoring Recommendations

- Pyrethroids
  - Low detection limits needed (see UP3 Project recs.)
  - Measure OC concentration & sediment grain size
  - Water—storm events most important
  - USGS developing standard sampling procedures
- Others: Malathion, Carbaryl, Fipronil, Pentachlorophenol
  - Fipronil — sediment + water column
  - Detection limits important (see UP3 Project recs.)

Photo courtesy USGS

Monitoring Recommendations

- Locations of Greatest Interest Are Nearest Sources
  - Marinas
  - Creek mouths
  - POTW discharges
    - Avoid overlap with permit-required monitoring
  - River/Delta (Ag Sources)
- Most Important Timing — Storm Events