Aquatic Risk Assessment

Organophosphate insecticide mixtures in Washington surface waters

Chlorpyrifos, diazinon, & malathion:
2018 – 2020 preliminary analysis

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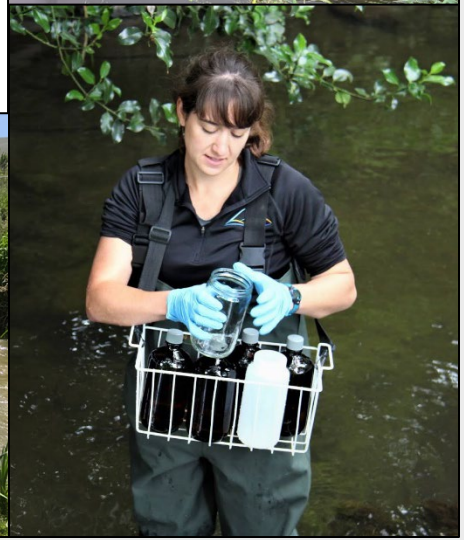
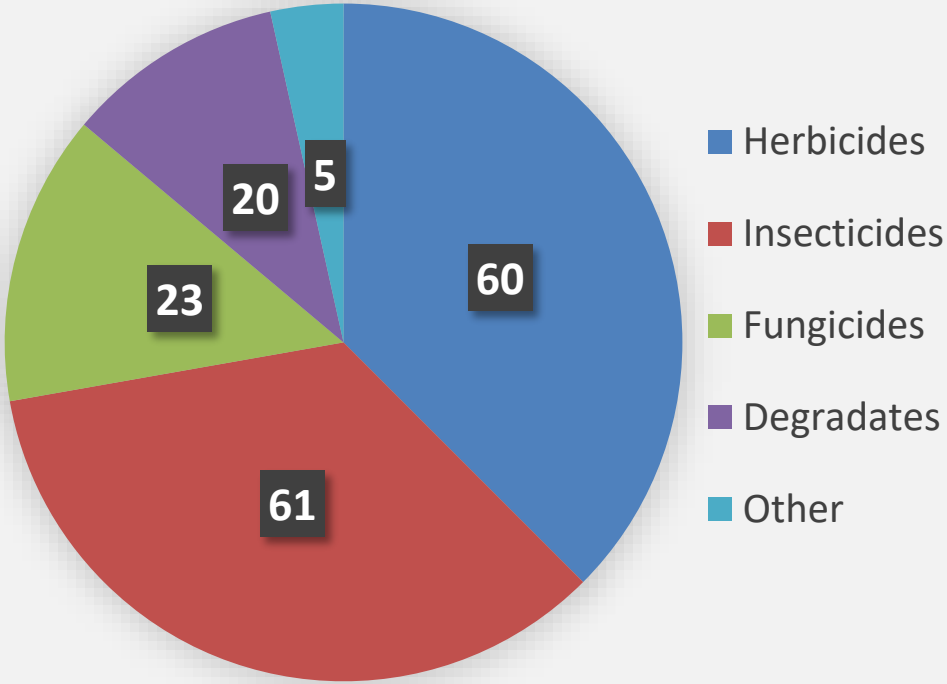
WSDA Surface Water Monitoring Program

- Natural Resources Assessment Section established in 2003
- Sample agricultural and urban streams Mar – Nov*
  - All streams currently or historically provided habitat for ESA listed salmonids



Monitoring Parameters



Jointly run EPA and WA Dept. of Ecology Manchester Environmental Lab

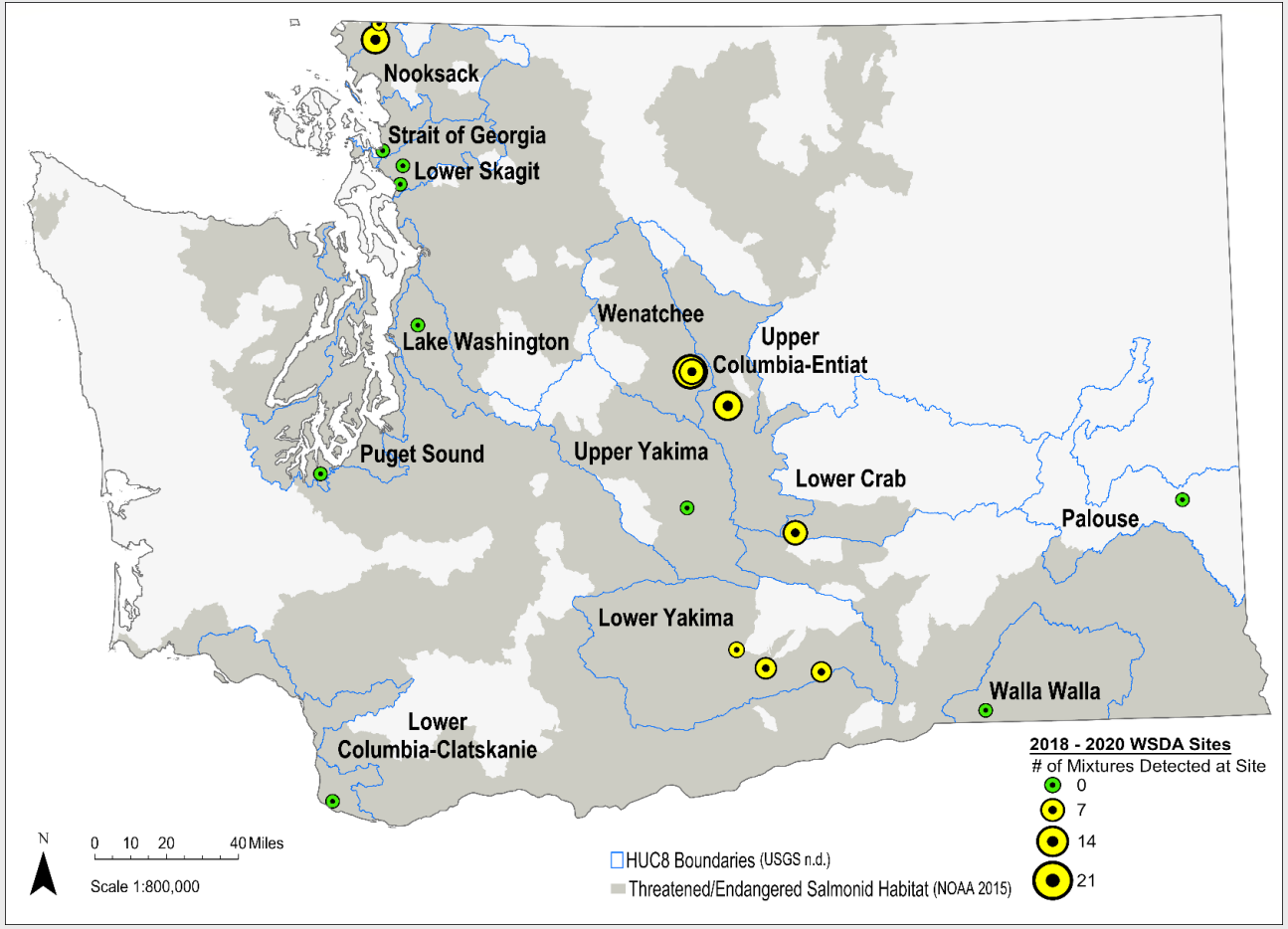
Field Measurements

- Streamflow
- Stage
- pH
- Temperature
- Specific Conductivity
- Dissolved Oxygen

Organophosphate Overview

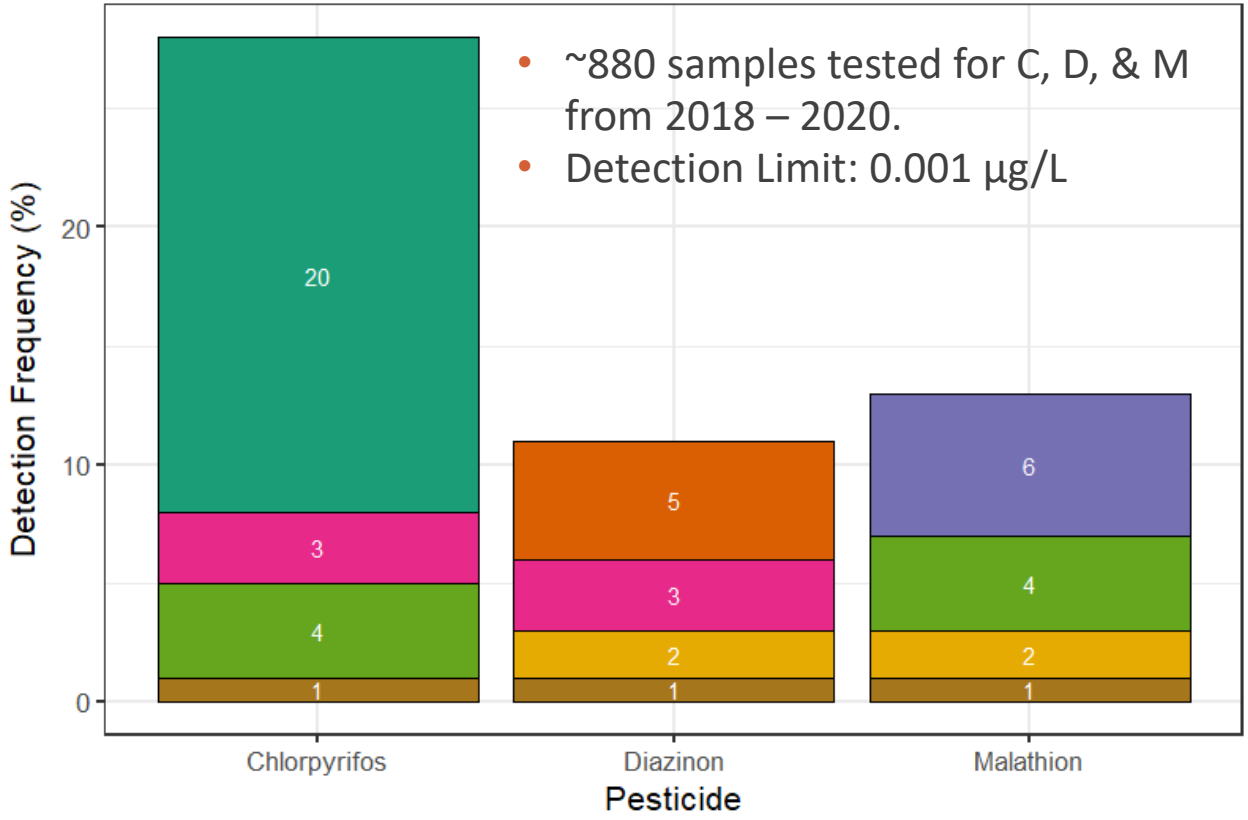
	Chlorpyrifos	Diazinon	Malathion
# Products	43	10	22
Uses			
Solubility	Low	Moderate	Moderate
Persistence in Water	Low	High	Low
	Tolerances expire Feb. 28, 2022		

Monitoring Sites



	ESA Status
Chinook	Endangered
Chum	Protected
Coho	Protected
Sockeye	Endangered
Steelhead Trout	Threatened

Detection Frequencies



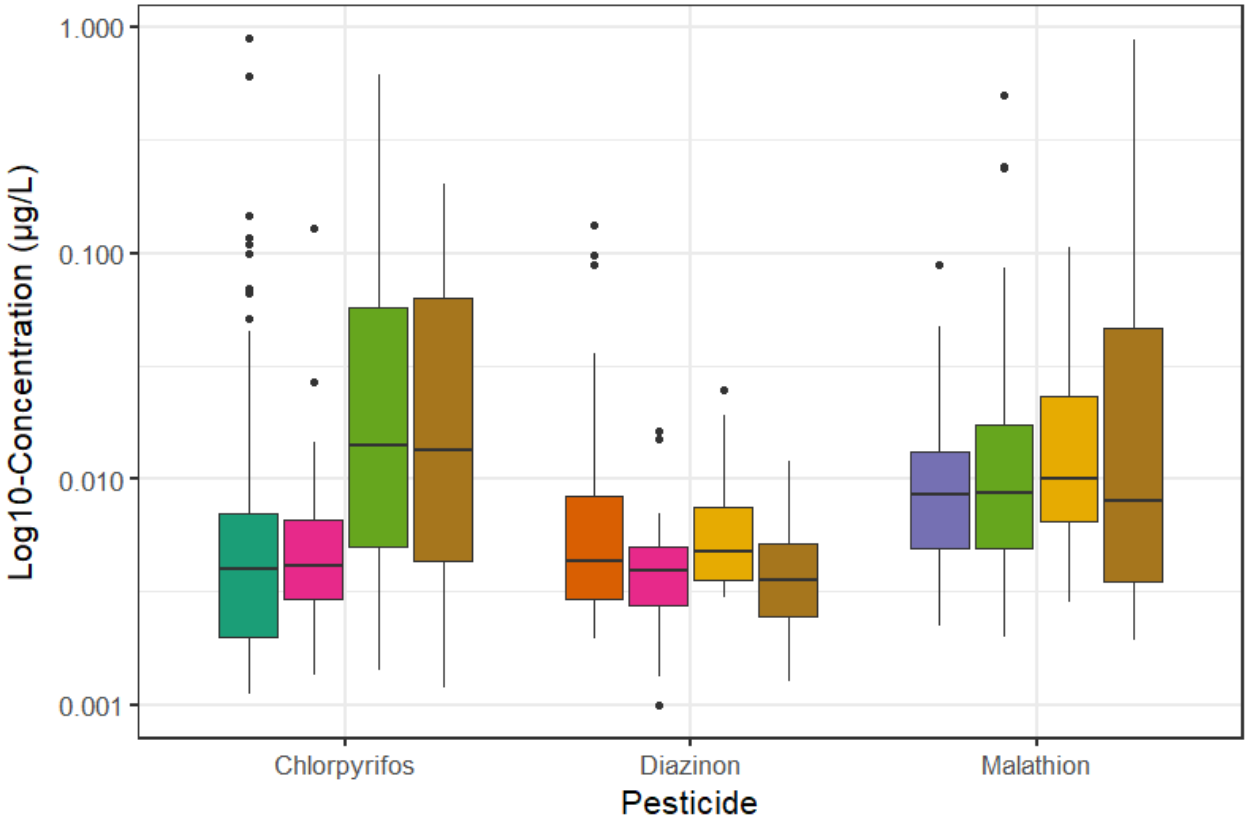
- ~880 samples tested for C, D, & M from 2018 – 2020.
- Detection Limit: 0.001 µg/L

Mixture (# of Detections)

C	(172)
D	(47)
M	(55)
CD	(28)
CM	(39)
DM	(15)
CDM	(12)

- Detections are not double counted across mixtures.

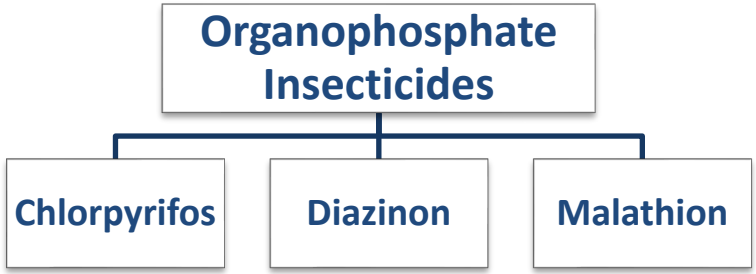
Measured Concentrations

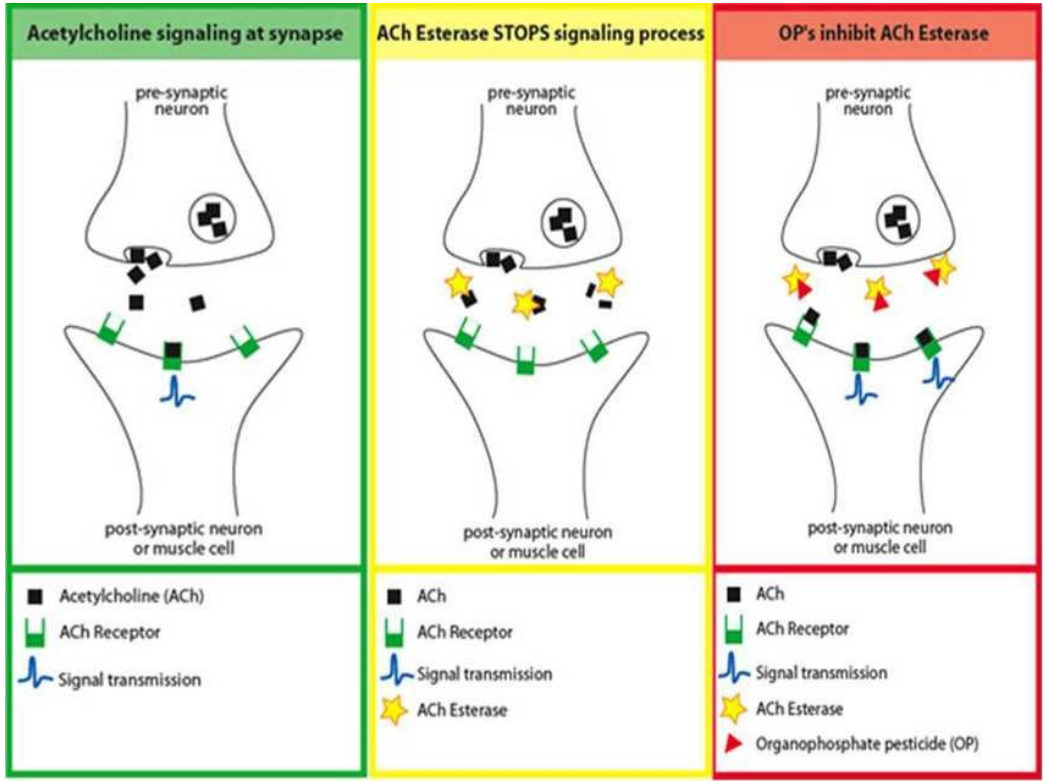


- Concentrations generally higher and more variable in mixtures with C & M

Concentration Addition Model

- Chemicals must have similar mode of action
- Assumes additive effects
- Conservative, screening level risk assessment





(ACh Figure: George et al. 2014)

Benchmark Quotient (BQ)

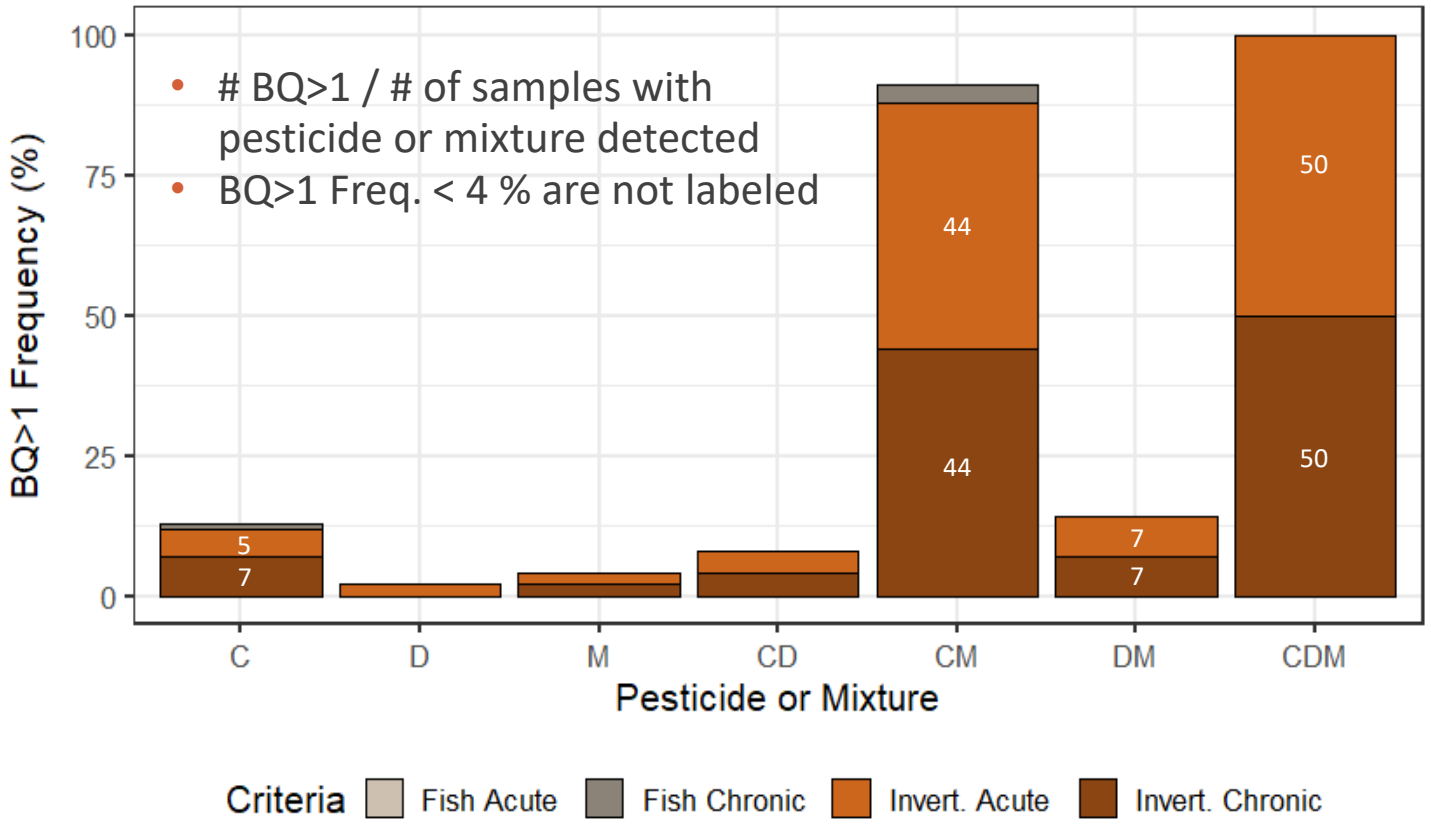
	Invertebrate		Fish	
	Acute (µg/L)	Chronic (µg/L)	Acute (µg/L)	Chronic (µg/L)
Chlorpyrifos	0.05	0.04	0.9	0.57
Diazinon	0.105	0.17	45	0.55
Malathion	0.049	0.06	2.05	8.6

Aquatic Life Benchmarks (EPA 2021)

$$Individual\ BQ = \frac{\text{Measured Concentration}}{\text{Benchmark}}$$

$$Mixture\ BQ = \sum_{i=1}^{n} \frac{\text{Measured Concentration}_i}{\text{Benchmark}_i}$$

BQ>1 Frequencies



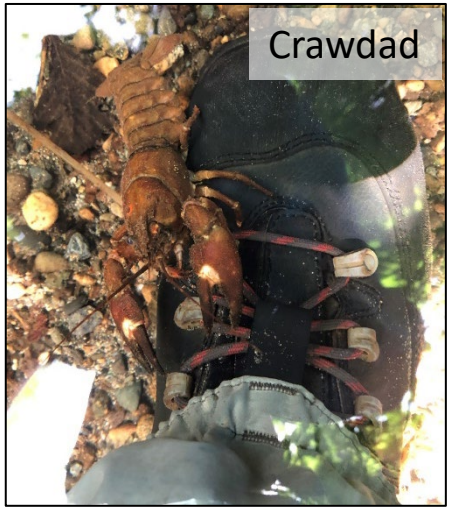
Conclusions

- C & M most frequently detected AND most frequently BQ>1
  - Likely primary contributors to overall toxicity of each mixture

- Mixtures after C tolerance revocation?

Conservatism and Uncertainty

- EPA ALBs apply safety factor (LOC) of 0.5 or 1 to lowest toxicity value (EC_{50}, LC_{50}, or NOAEC)



- BQ analysis did not consider:
  - Water quality parameters
  - Pesticide properties
  - Spatial or temporal patterns

Future Work

- Refine RA based on more specific scenarios

- Only assessed OP mixtures
  - In 2018, up to 44 different analytes were detected in a single sample

- Assess more pesticide groups with same mode of action

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Thank you!

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