Advancing Endangered Species Act Consultations

Use of an Automated, Computational Pipeline to Extract Points of Departure from Public Data Sources
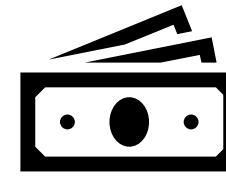
Monique Hazemi[1], Dan Villeneuve[2], Andrea LaTier[3], Mark Jankowski[3], Carlie LaLone[2], Christopher Schaupp[1], Manli Chan[4], Derik Haggard[4], Kali Mattingly[5]

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Summary: POD estimates derived from the automated pipeline tended to be at lower or approximately equal concentrations compared to manually derived results, providing evidence that the app can provide reasonable, and generally protective, PODs for ESA consultations.

POD

ESA consultations

This presentation neither constitutes nor necessarily reflects official US EPA policy.

Background

- Endangered Species Act (ESA) consultations are complicated and time and resource intensive
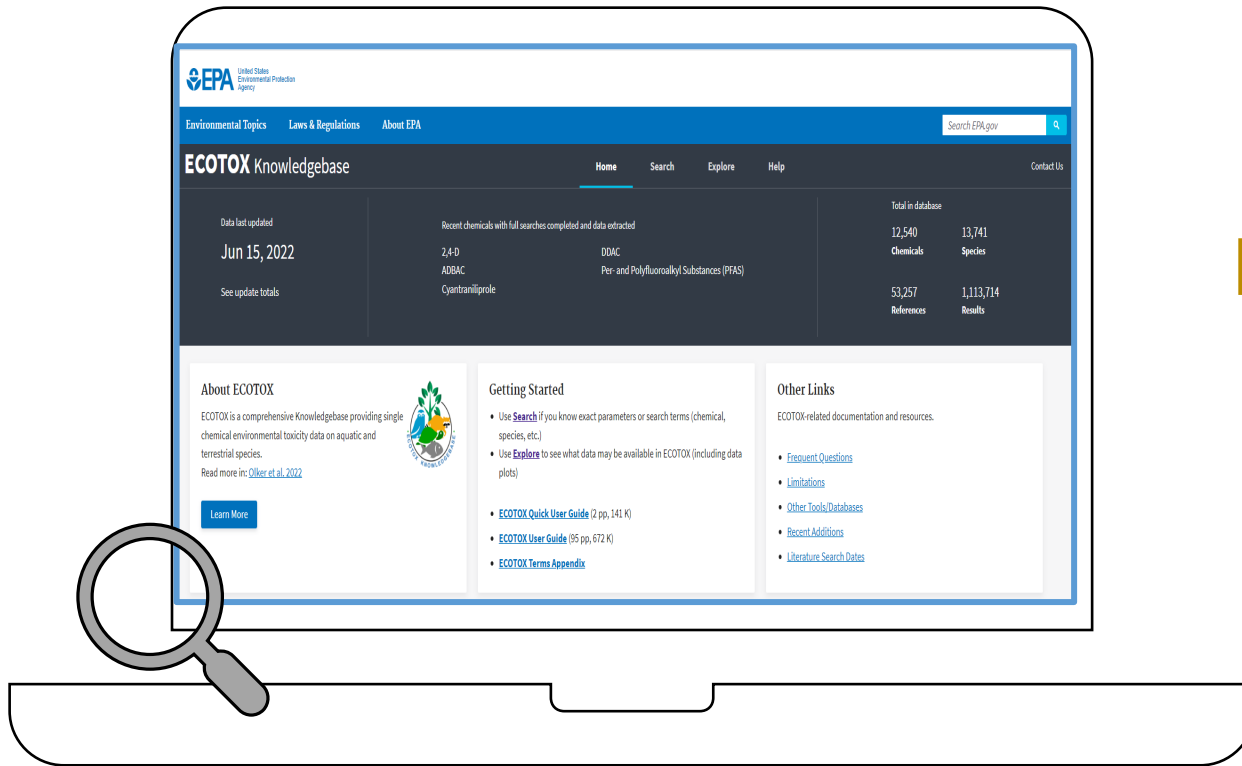 - Species-specific toxicity analyses required for each chemical
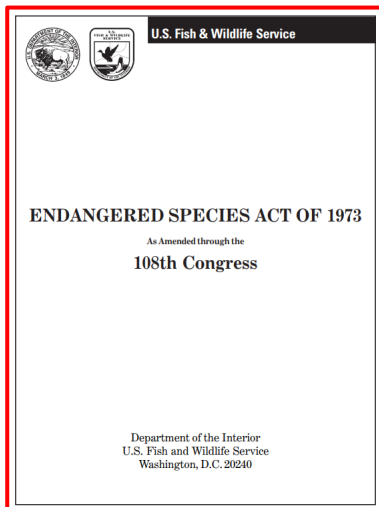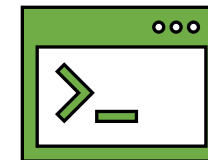
Discharge → BDE-47
DTXSID3030056 → Coho salmon

Objective

(For more info see next presentation by Dale Hoff: 5.01.T-03 - The ECOTOXicology Knowledgebase…)
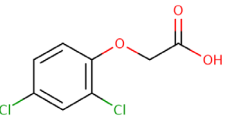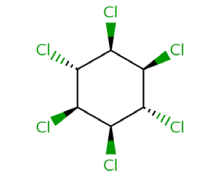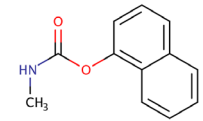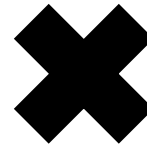
Coding

The App

Point of departure (POD) < manually derived toxicity benchmark value ???

Methods – Query chemicals & species

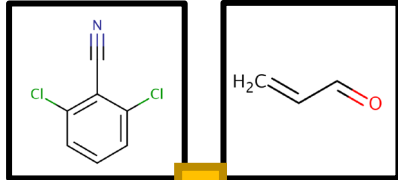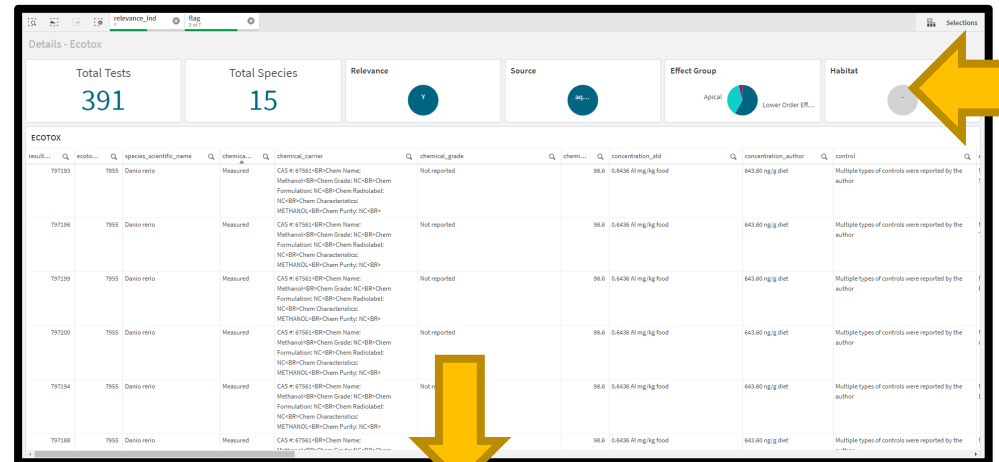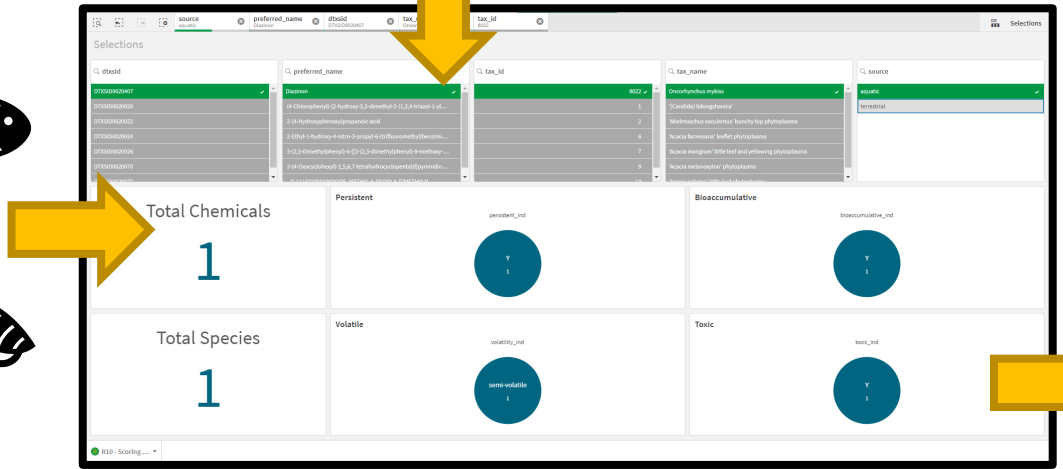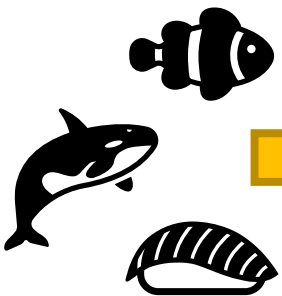| Chemical |
|---|
| 2,4-Dichlorophenoxyacetic acid |
| 4-Nonylphenol |
| Acrolein |
| Carbaryl |
| Diazinon |
| Dichlobenil |
| Dieldrin |
| Endrin |
| Heptachlor |
| Lindane |
| Pentachlorophenol |

✖

Broad range of taxa and mode of actions (herbicides, insecticides, fungicides, some have multiple uses)

Species	
Vernal pool fairy shrimp	*Branchinecta lynchi*
Steelhead	*Oncorhynchus mykiss*
Foskett speckled dace	*Rhinichthys osculus ssp.*
Bocaccio rockfish	*Sebastes paucispinis*

Photo credits: shrimp (Dwight Harvey USFWS), steelhead (USFWS), dace (Doug Markle OSU), rockfish (SWFSC ROV team)

Calculated Summed Score

Calculated Taxon Match Score

1. Min POD

2. Min POD x highest taxon match

3. Min POD x highest sum score

TRV & WQC from Biological Evaluations

Comparison category

- App POD > manual value by more than a factor of 10
- App POD > manual value but within a factor of 10
- App POD < manual POD (i.e., protective)
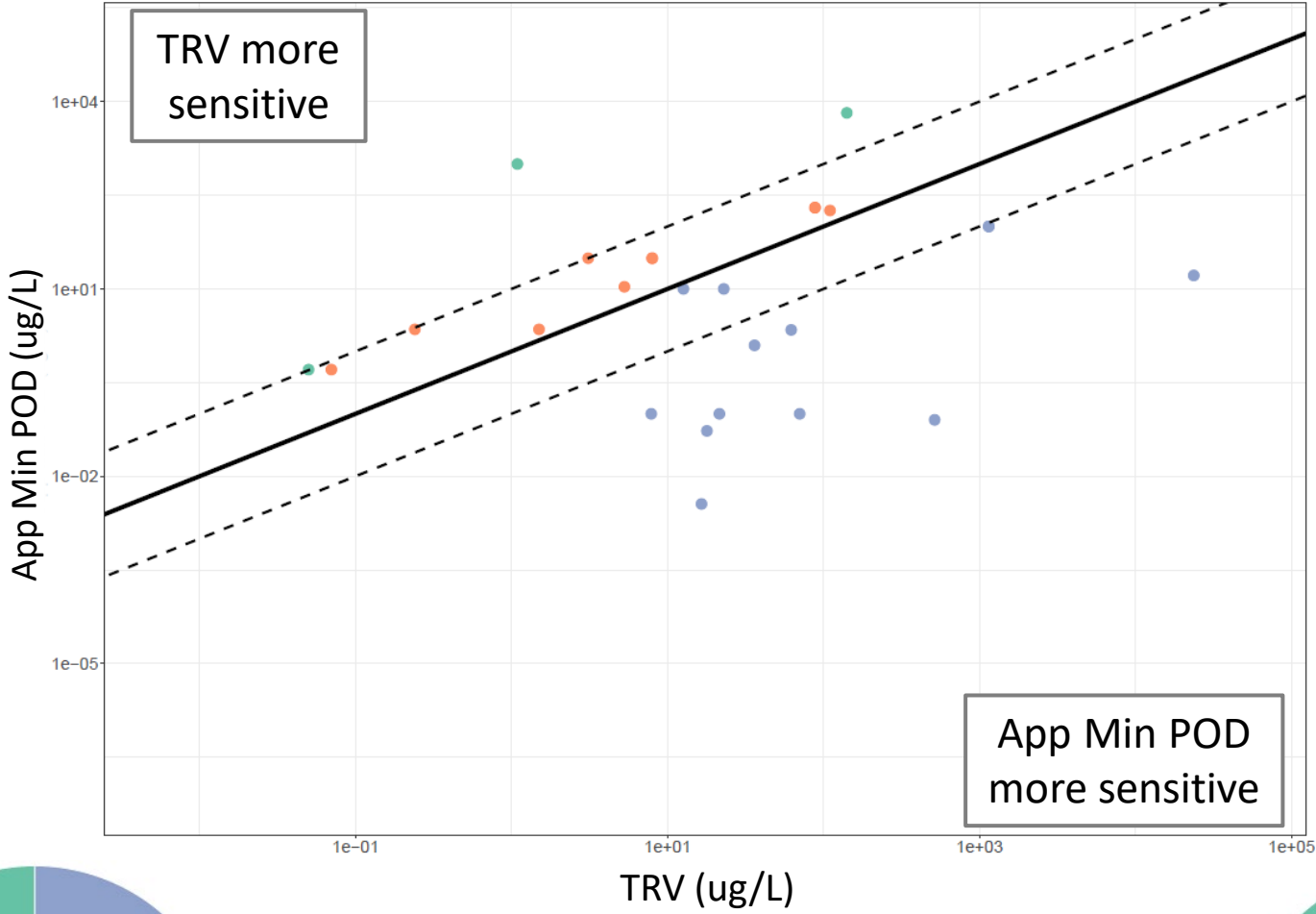
App Min POD vs. TRV

App Min POD Tax Match vs. TRV

App Min POD Sum Score vs. TRV

App-derived PODs > 10x WQC in majority of cases

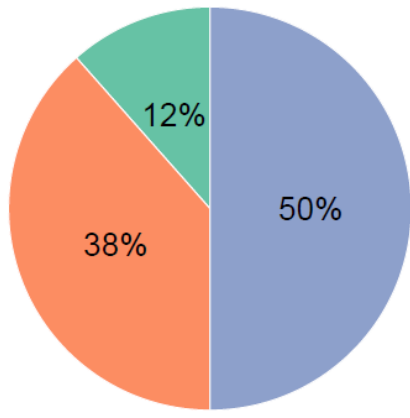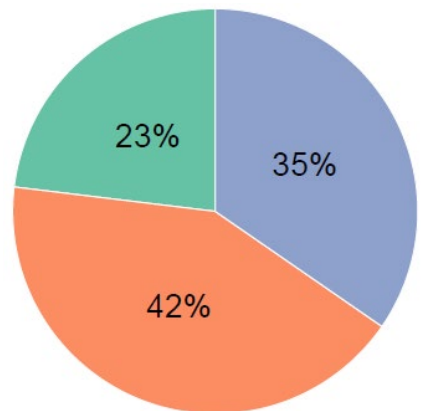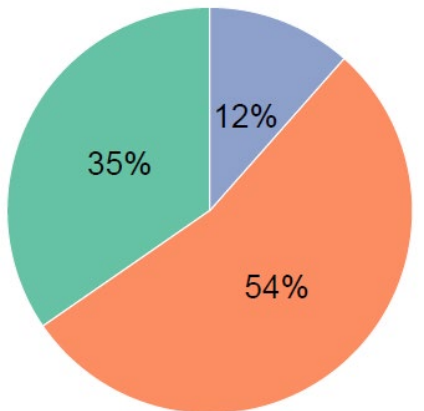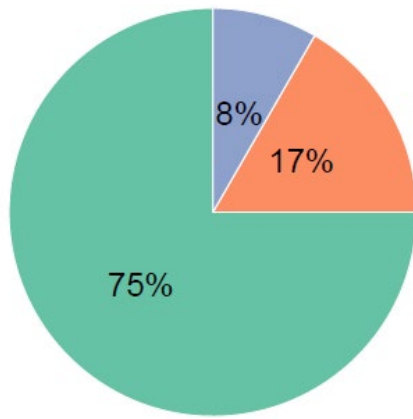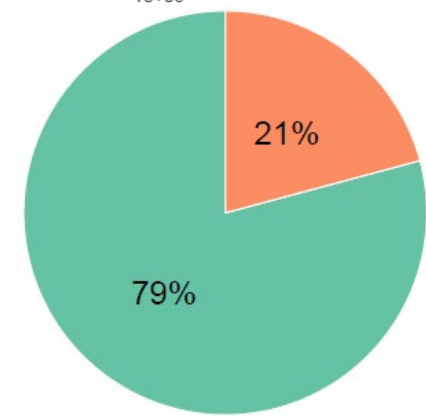# Concordance analysis: Paired t-test, Wilcoxon matched pairs signed rank test

Measure 1 (log10)	Measure 2 (log 10)	Paired t p-value	Paired t statistic	Wilcoxon p-value	Wilcoxon V statistic
TRV	Min POD	0.087	1.77		
TRV	Min POD SS			0.00011	33
TRV	Min POD TM	0.13	-1.57		
WQC	Min POD			0.089	108
WQC	Min POD SS			8.74E-06	0
WQC	Min POD TM	4.90E-05	-4.89		

4/6 cases where app-derived PODs were lower or ≈ equal to manually-derived TRV or WQC

Agreement analysis: Intraclass correlation

2/6 cases where app-derived PODs and manually-derived TRV or WQC were concordant.

Poor and moderate degree of concordance.

Measure 1 (log10)	Measure 2 (log 10)	ICC p-value	ICC
TRV	Min POD	0.13	0.20
TRV	Min POD SS	0.027	0.40
TRV	Min POD TM	0.00015	0.61
WQC	Min POD	0.36	0.065
WQC	Min POD SS	0.26	0.056
WQC	Min POD TM	0.30	0.061

Conclusions

- Benefits of the app
  - Yields generally protective PODs for evaluated range of Endangered species and chemicals
    - ❖ App min POD is most conservative of 3 types, with min POD Taxon Match as runner-up
    - ❖ App min POD Taxon Match has highest degree of concordance with TRV
  - Helps standardize and track screening of chemicals for evaluation
  - Expedites assessment of toxicity data to prioritize BE development
    - 1 hr vs. 8 - 40 hrs, per chemical-species pair

- Looking ahead…
  - Calculated adjustment factors for ESA assessments
  - Considering weighted scoring function

Photo credits: https://ecos.fws.gov/

Contributors

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The research presented here neither constitutes nor necessarily reflects official U.S. EPA policy.

Office of Research and Development
**Center for Computational Toxicology and Exposure**

References

- United States. (1983). The Endangered Species Act as amended by Public Law 97-304 (the Endangered Species Act amendments of 1982). Washington: U.S. G.P.O.

- Olker, J. H., Elonen, C. M., Pilli, A., Anderson, A., Kinziger, B., Erickson, S., Skopinski, M., Pomplun, A., LaLone, C. A., Russom, C. L., & Hoff, D. (2022). The ECOTOXicology Knowledgebase: A Curated Database of Ecologically Relevant Toxicity Tests to Support Environmental Research and Risk Assessment. Environmental Toxicology and Chemistry, 41(6):1520-1539. https://doi.org/10.1002/etc.5324

- Williams, A.J., Grulke, C.M., Edwards, J. et al. (2017). The CompTox Chemistry Dashboard: a community data resource for environmental chemistry. Journal of Cheminformatics, 9(61). https://doi.org/10.1186/s13321-017-0247-6

Extra

Summed Score Calculation

| Scoring Categories	Examples [*high to low preference score*]
Taxonomic match	Species, genus, family, order, class…..
Effect type	Apical, neuro-endocrine-immune, lower order
POD type	More protective (e.g., LC10, vs. LC50) > score
Exposure type	Flow through, renewal, static…..
Control type	Multiple controls, concurrent control, historical control…
Exposure verification	Measured, nominal only
Summed Score	**Sum of each scoring category (normalized to max score possible in category) – max. = 6**

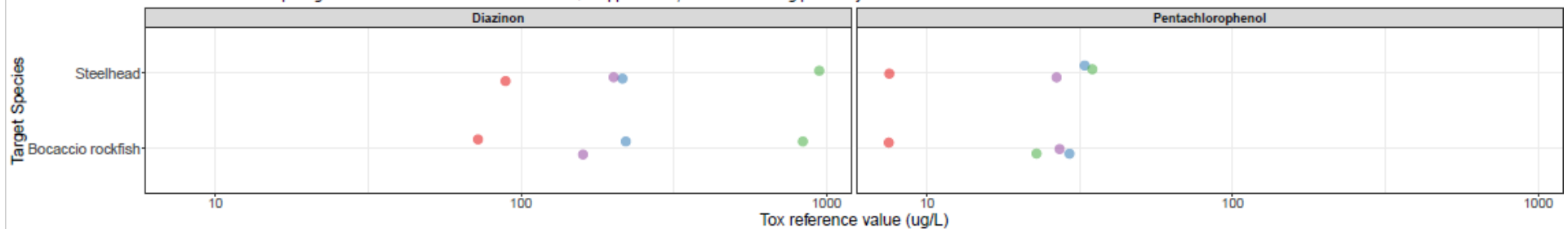Fresh/Acute: Comparing 3 Min POD Calculation Methods from Qlik App vs. TRV, Subset-matching pairs only
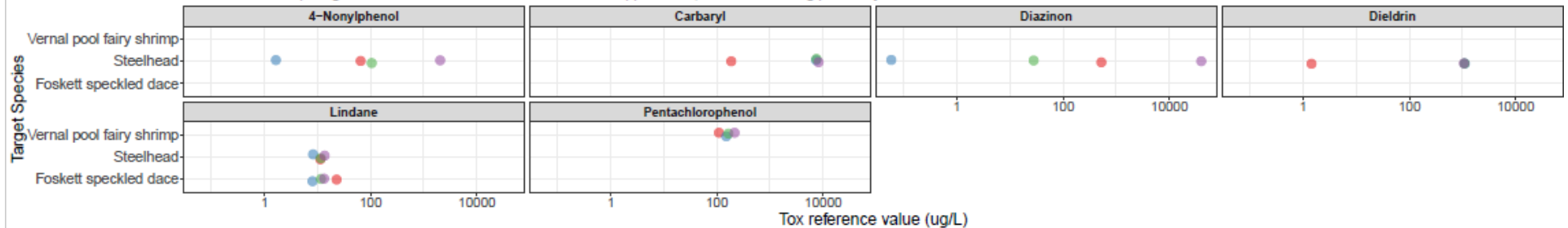
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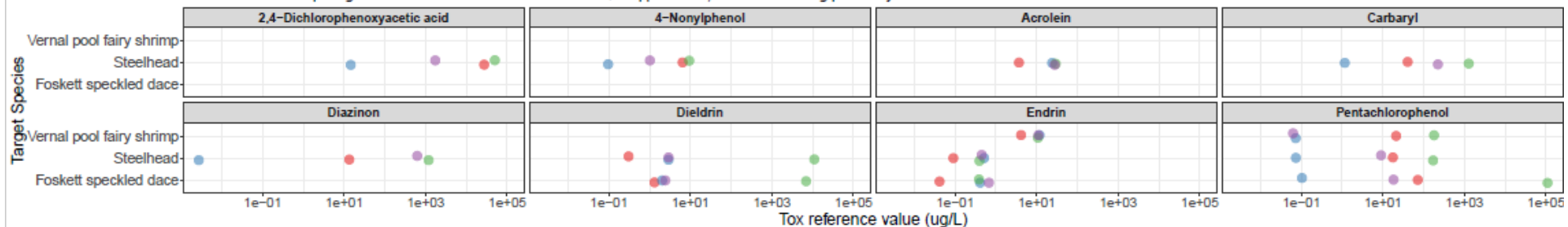
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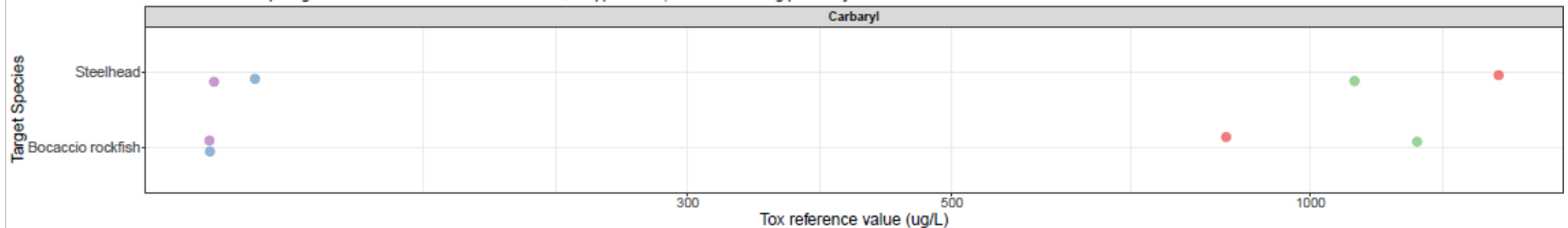
Marine/Chronic: Comparing 3 Min POD Calculation Methods from Qlik App vs. TRV, Subset-matching pairs only

Tox Reference Type
- TRV
- Min POD
- Min POD Sum Score
- Min POD Tax Match

Fresh/Acute: Comparing 3 Min POD Calculation Methods from Qlik App vs. WQC, Subset-matching pairs only

Fresh/Chronic: Comparing 3 Min POD Calculation Methods from Qlik App vs. WQC, Subset-matching pairs only

Marine/Acute: Comparing 3 Min POD Calculation Methods from Qlik App vs. WQC, Subset-matching pairs only

Marine/Chronic: Comparing 3 Min POD Calculation Methods from Qlik App vs. WQC, Subset-matching pairs only

Tox Reference Type
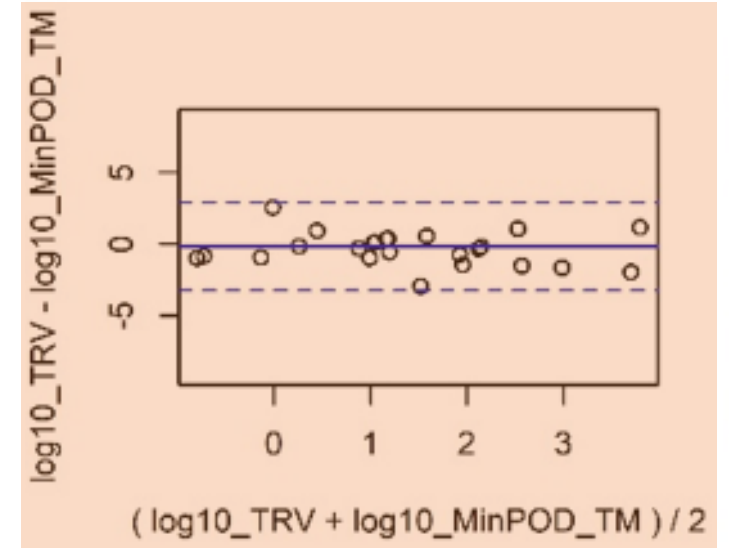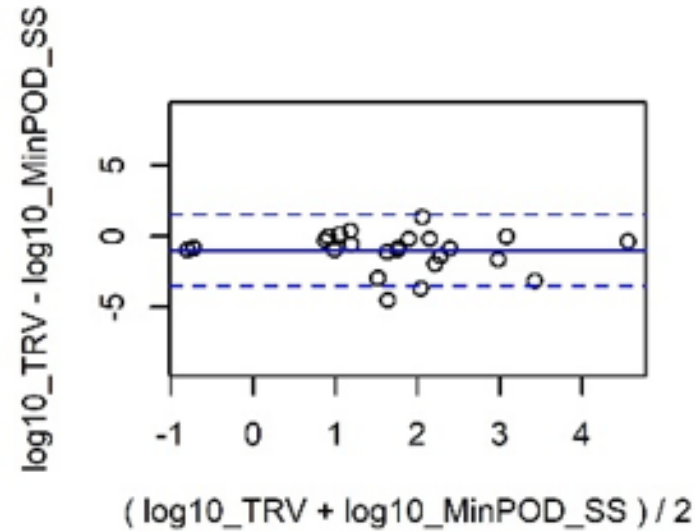- WQC
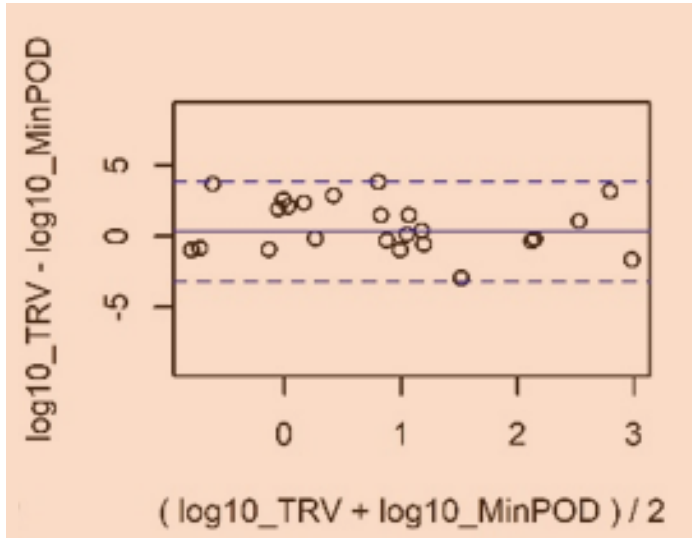- Min POD
- Min POD Sum Score
- Min POD Tax Match

Comparing 3 Min POD Calculation Methods from Qlik App vs. ACC5
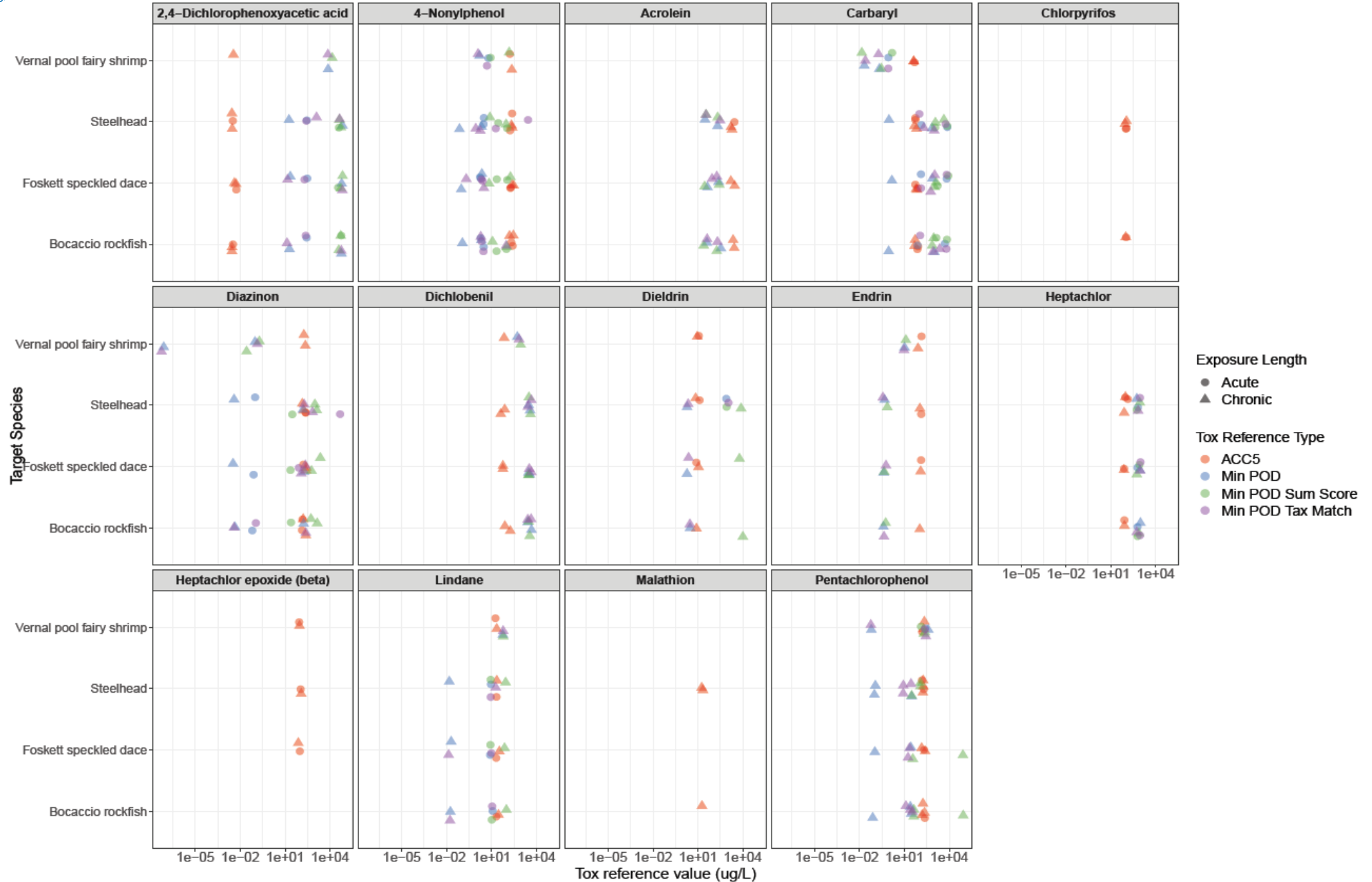
Agreement analysis: Bland-Altman
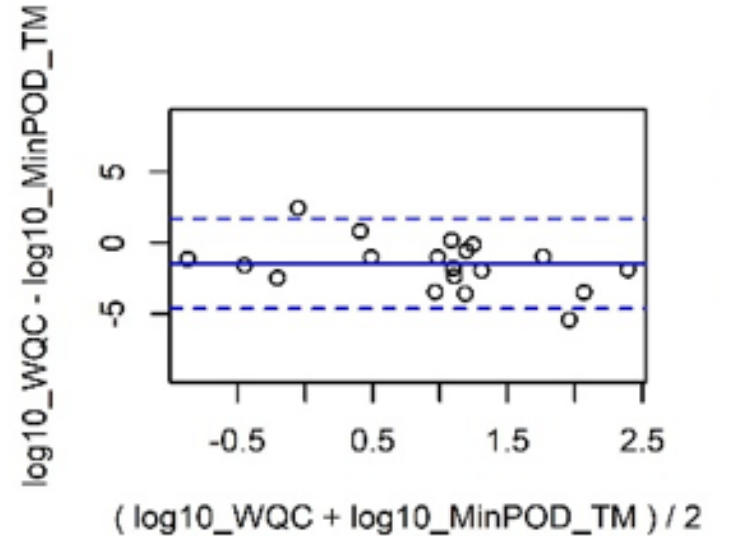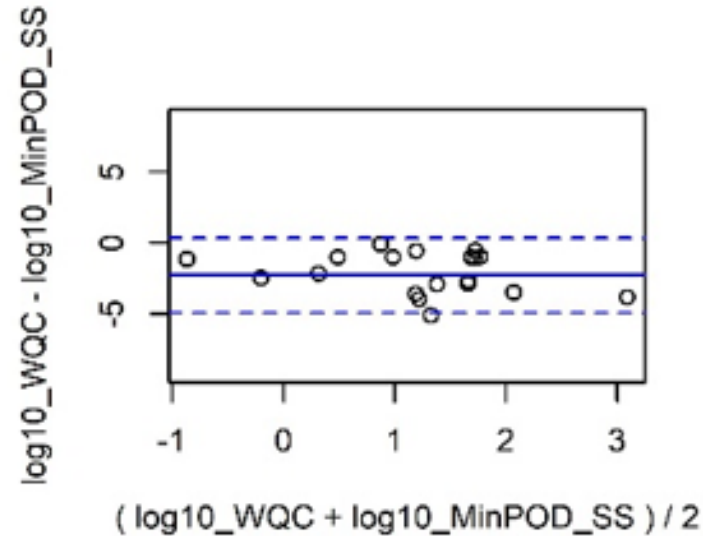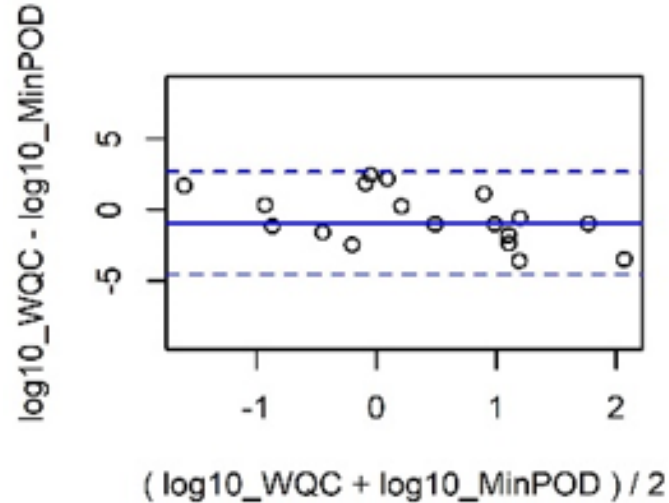
Bland-Altman Agreement Analysis

meas_1	meas_2	BA_mean_difference	BA_SD	BA_LoA_lo_95CI	BA_LoA_up_95CI
log10_TRV	log10_MinPOD	0.326	1.759	-3.191	3.844
log10_TRV	log10_MinPOD_SS	-1.021	1.248	-3.518	1.475
log10_TRV	log10_MinPOD_TM	-0.190	1.528	-3.246	2.866
log10_WQC	log10_MinPOD	-0.943	1.806	-4.556	2.669
log10_WQC	log10_MinPOD_SS	-2.291	1.314	-4.920	0.337
log10_WQC	log10_MinPOD_TM	-1.460	1.582	-4.625	1.704