

# MORE THAN DOABLE: An Examination of Statistical Methods Used to Analyze Time Trends in Contaminant Data Containing Nondetects

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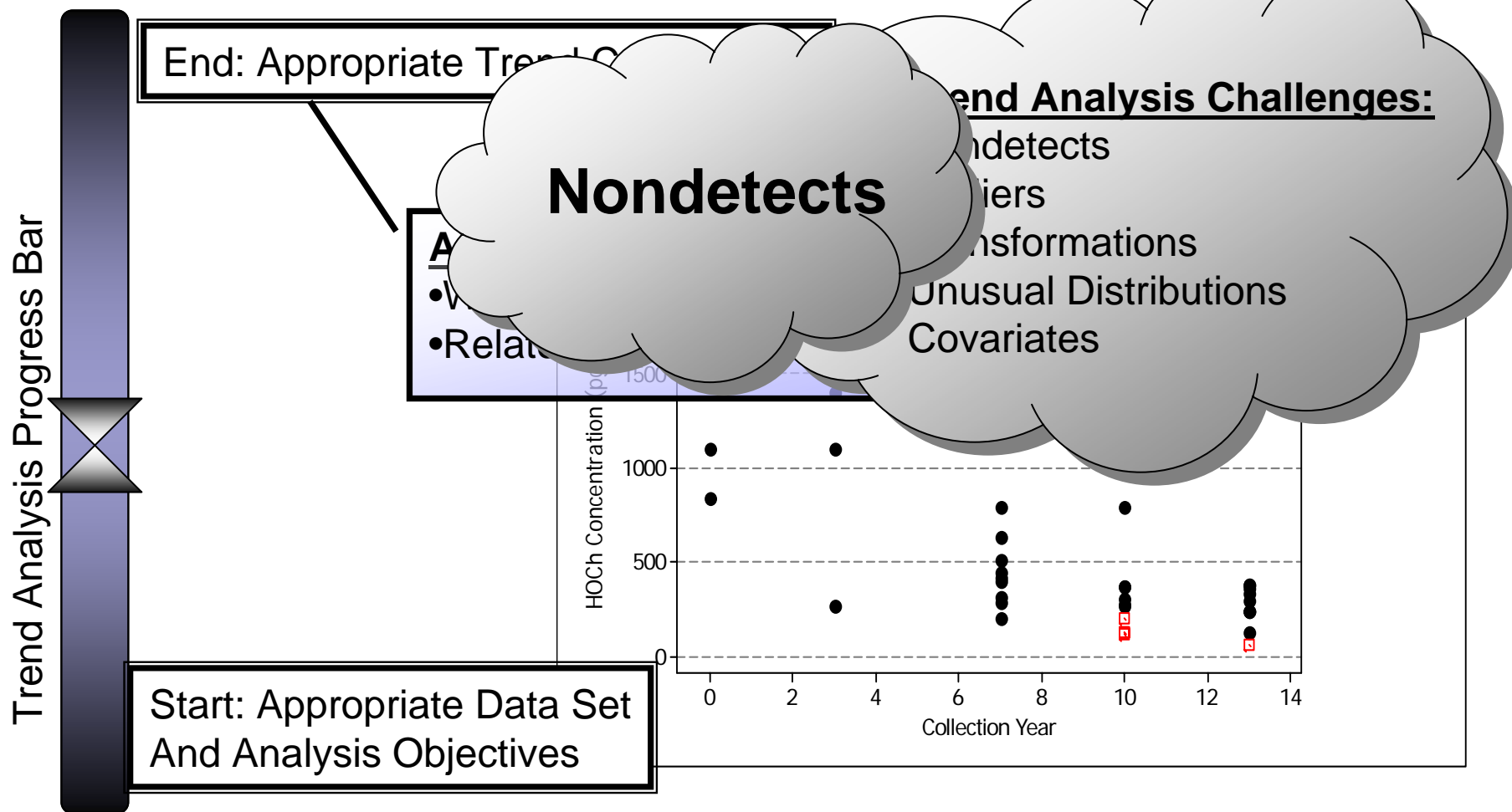


# Three Messages

- Methods to analyze data avoiding nondetect substitution are easier to use than in the past and offer important advantages to “substitution” methods;
- Method results will often differ from “substitution” methods in hard-to-predict ways;
- Careful application of data analysis methods is still important.

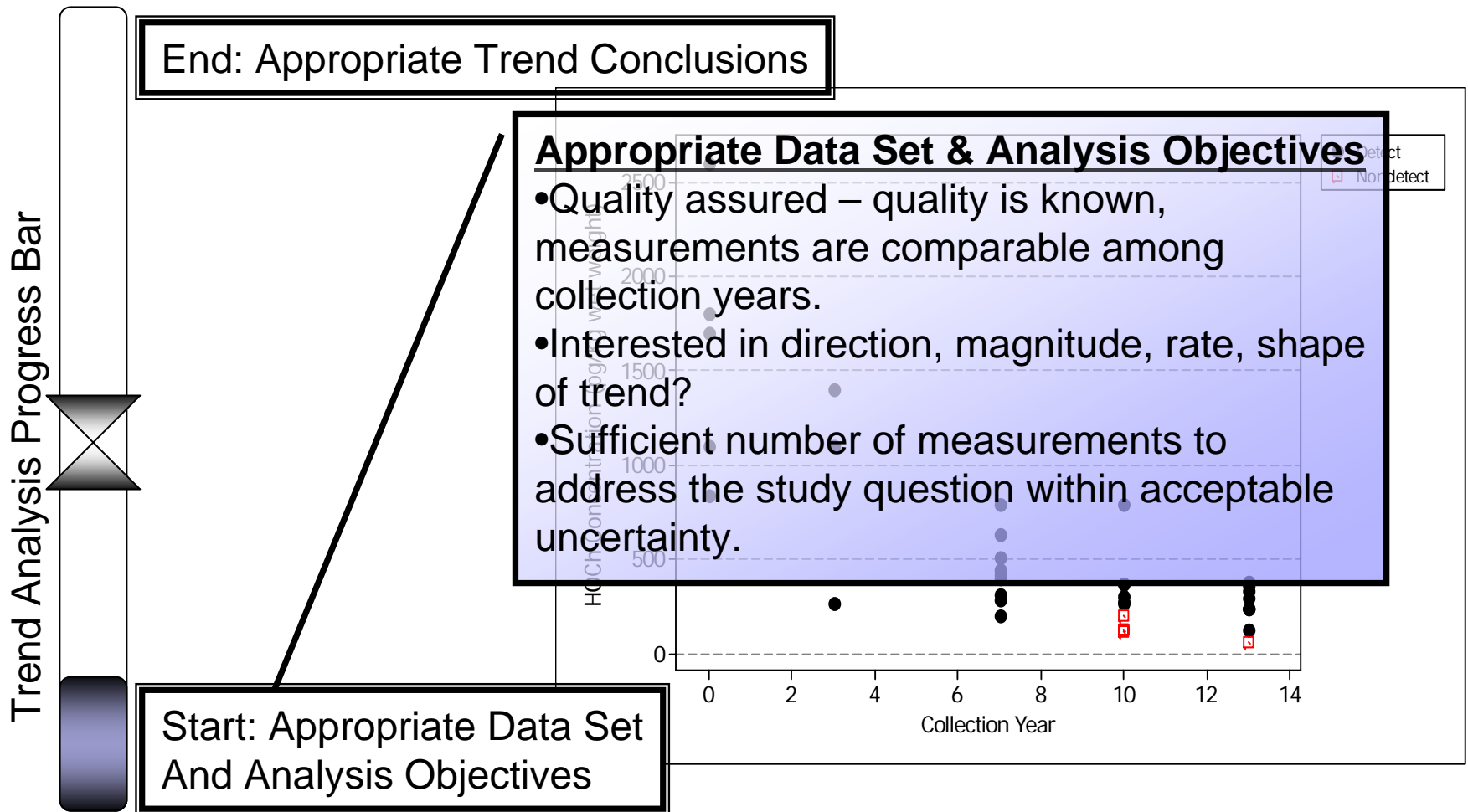
# Trend Analysis-Overview

HOC = Hydrophobic Organic Contaminants

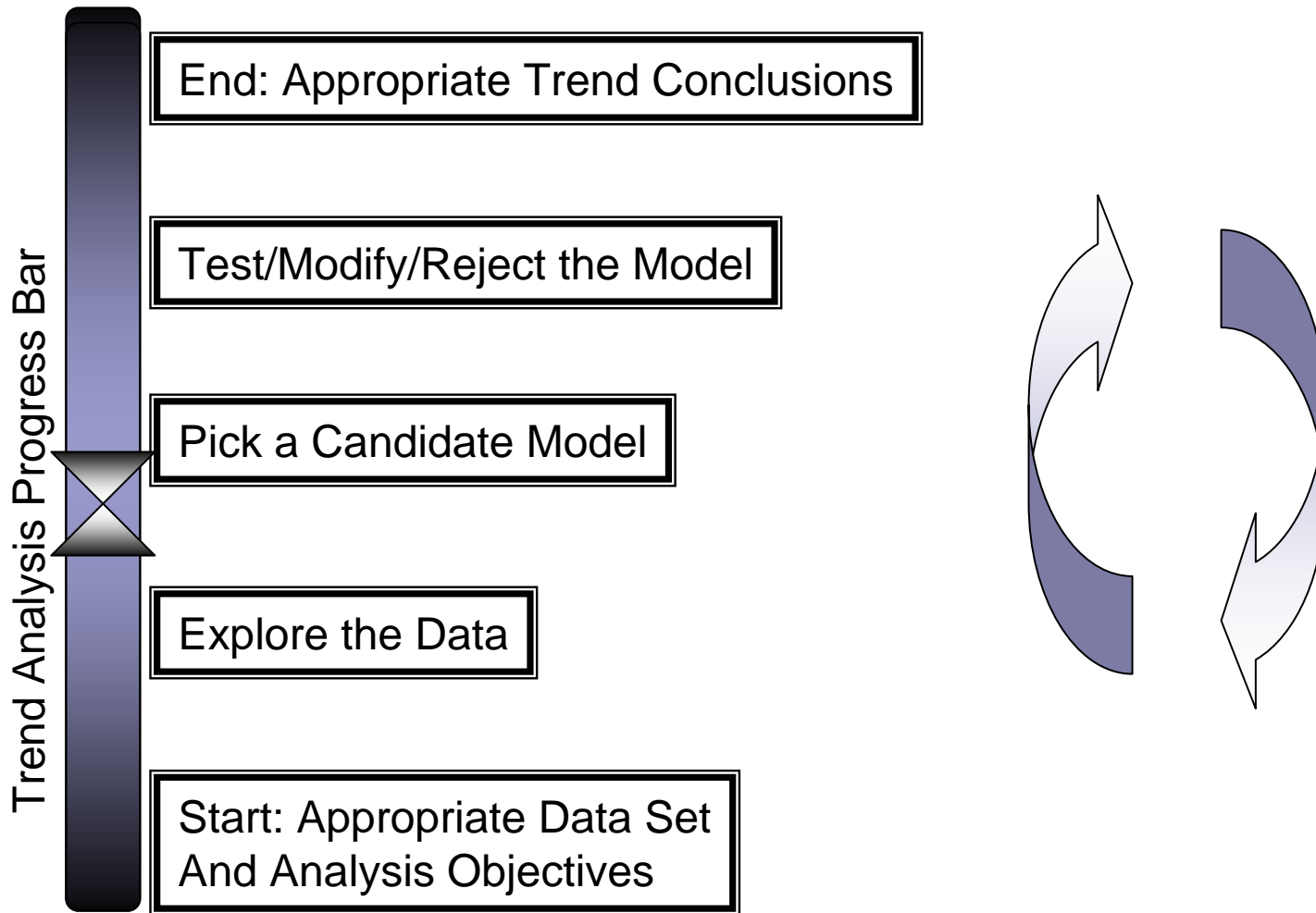


Assume "Retrospective" Analysis for this discussion

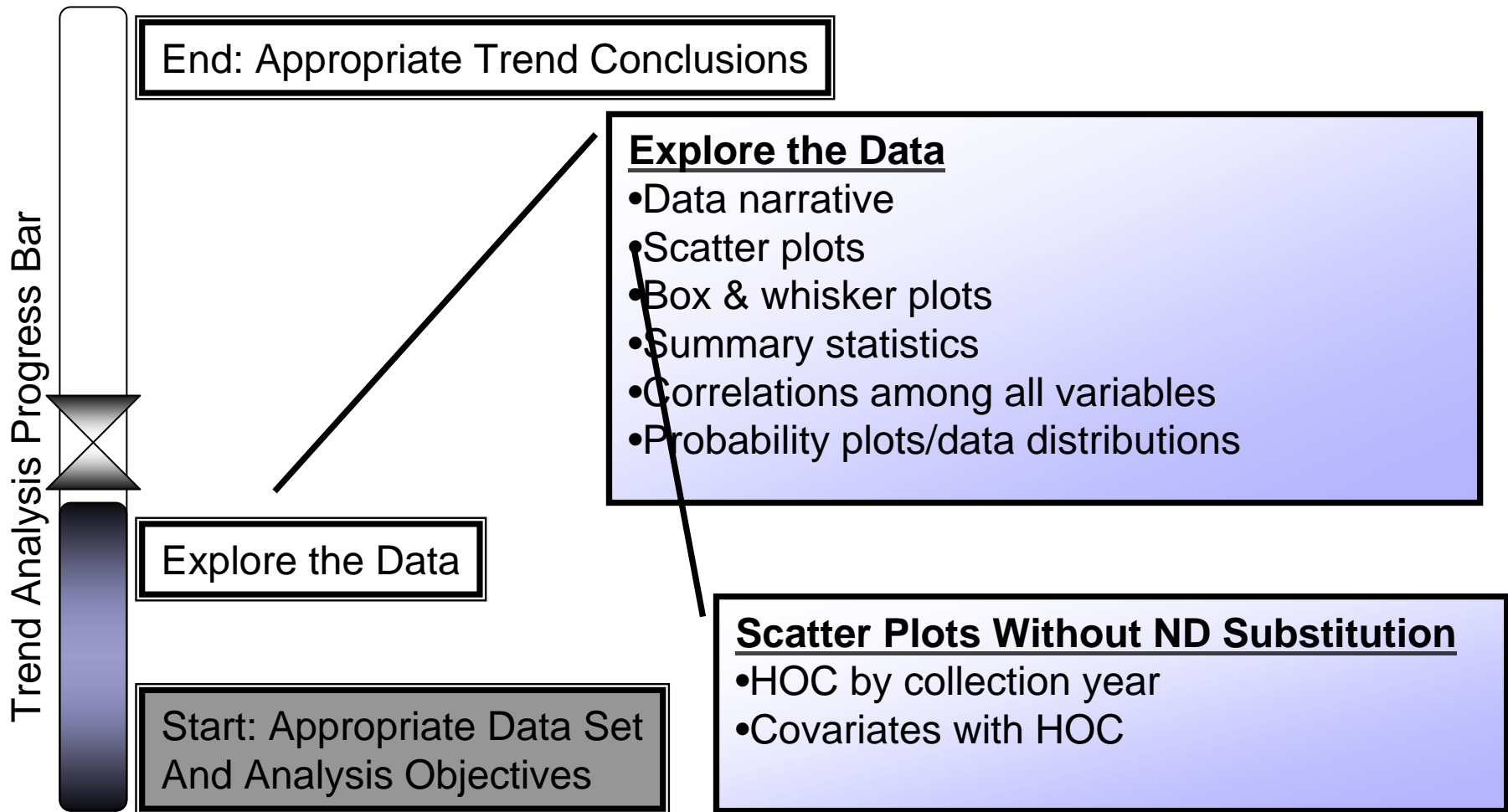
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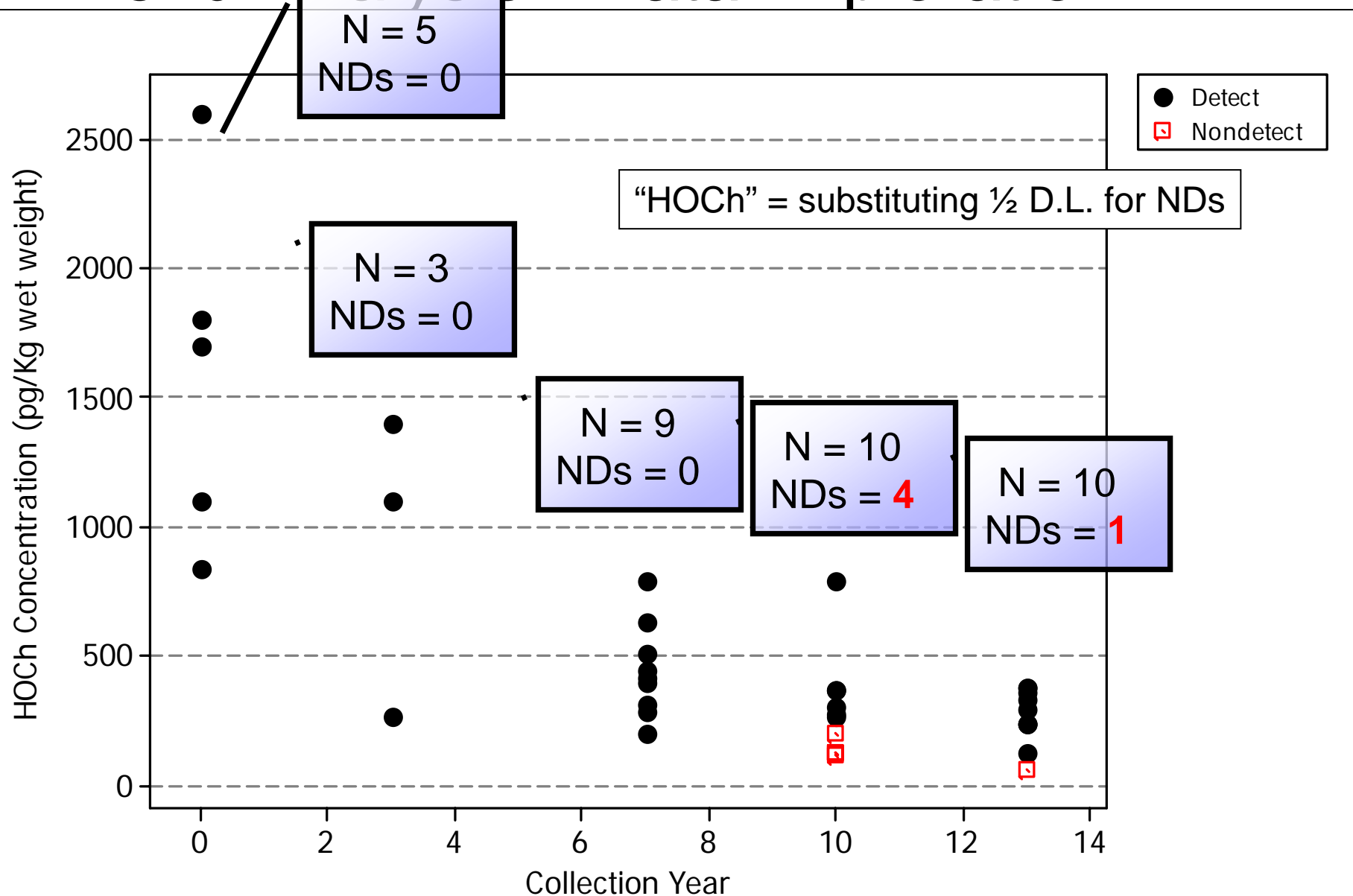
# Trend Analysis-Overview



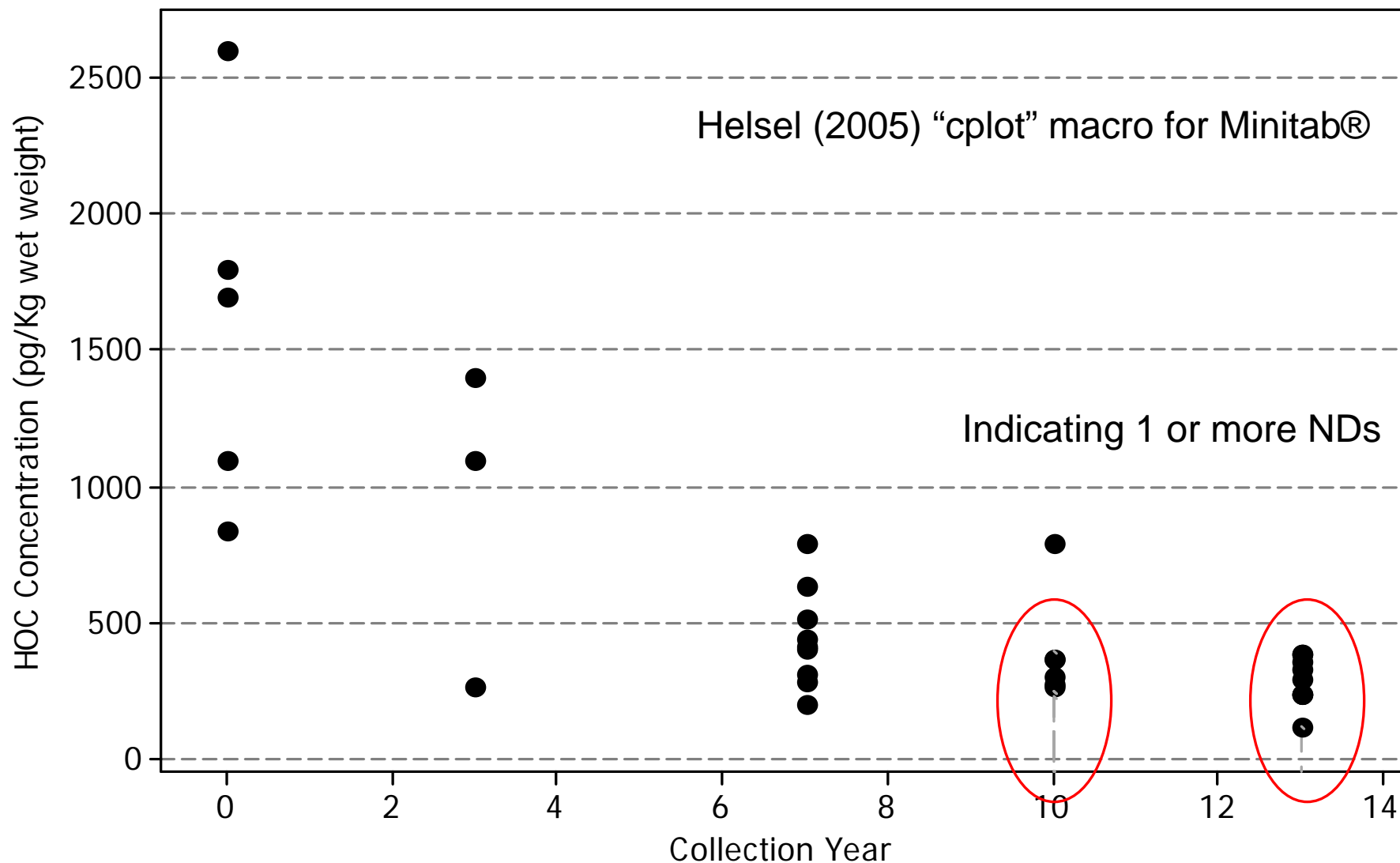
# Trend Analysis-Data Exploration



# Trend Analysis - Data Exploration

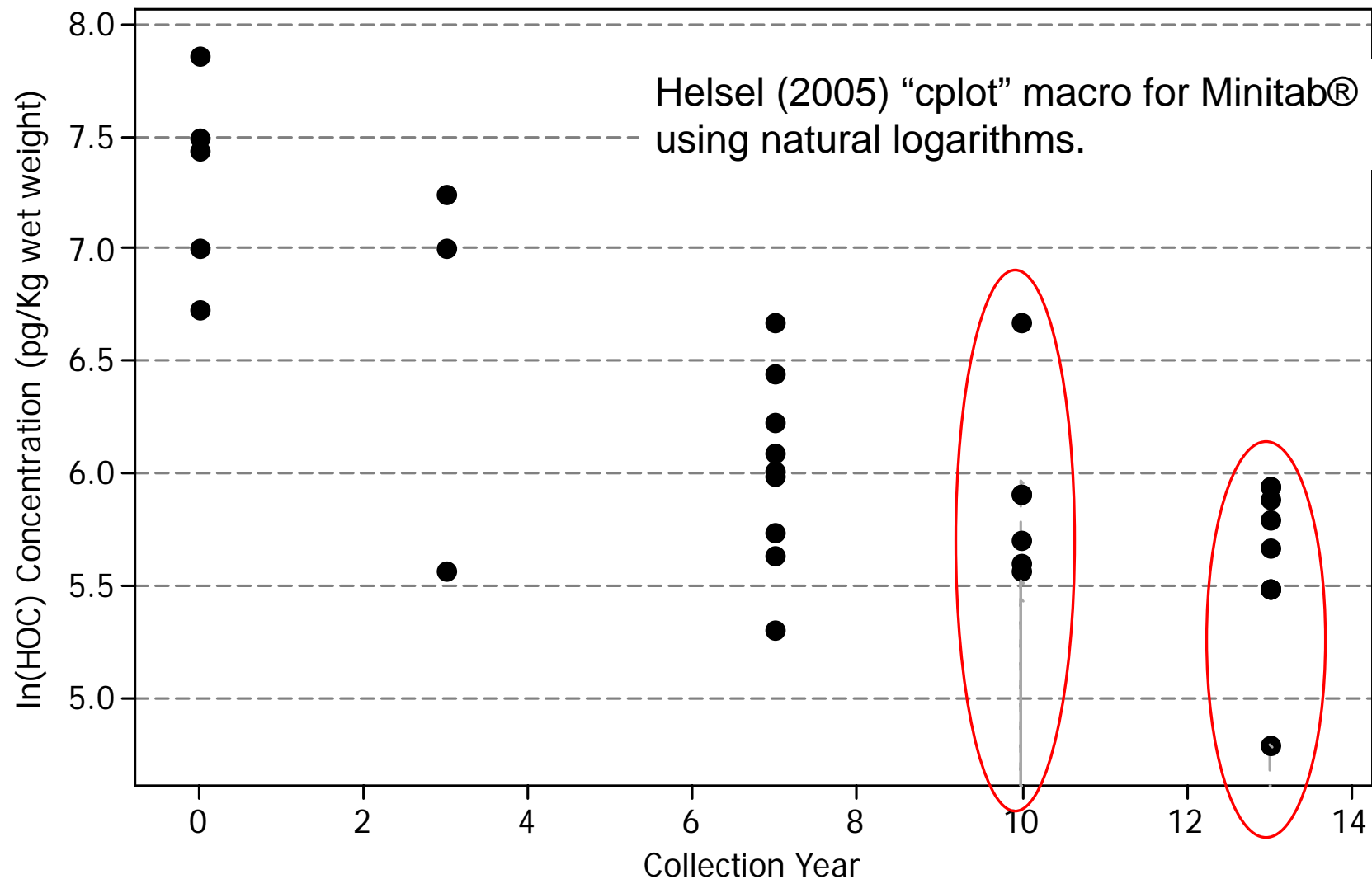


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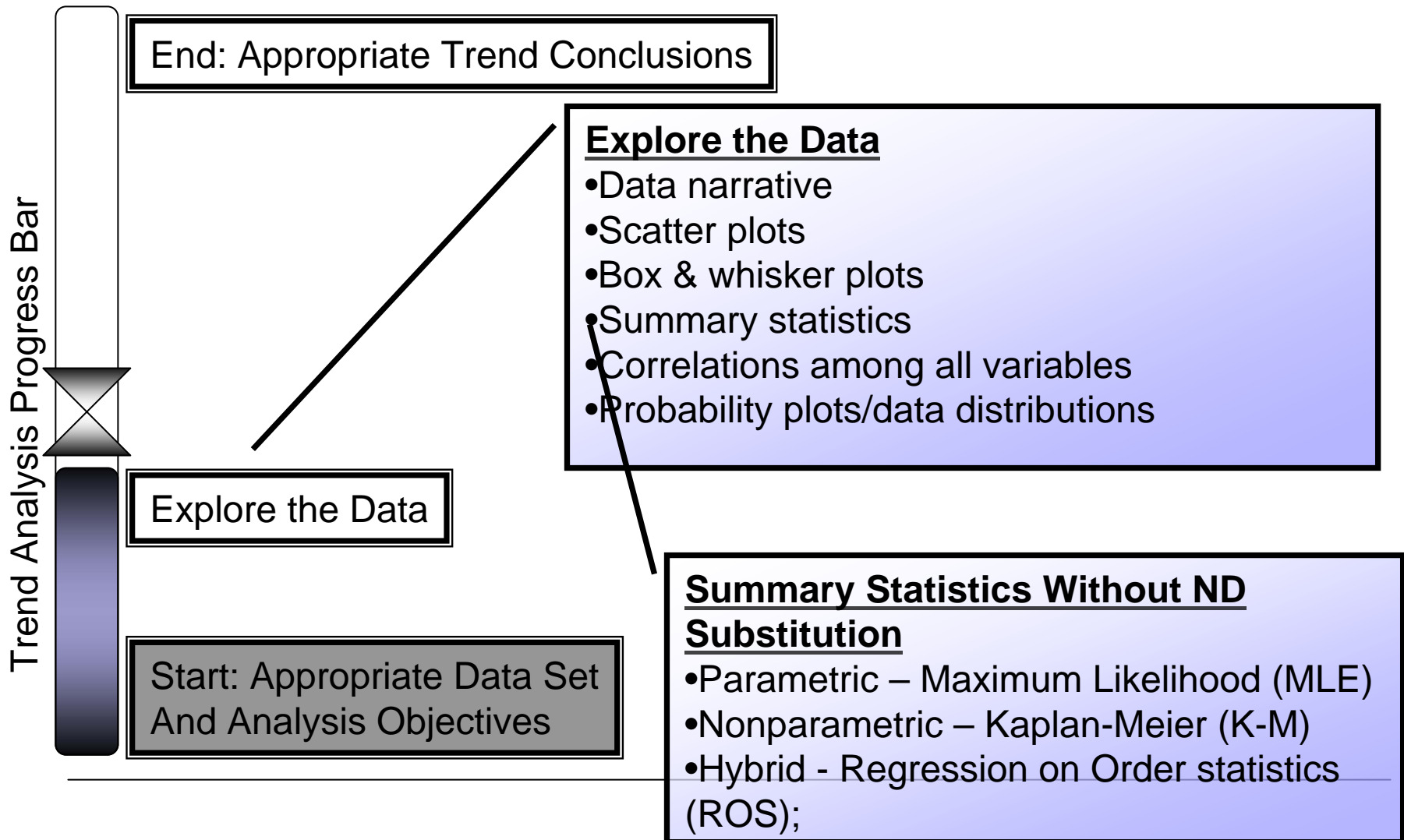




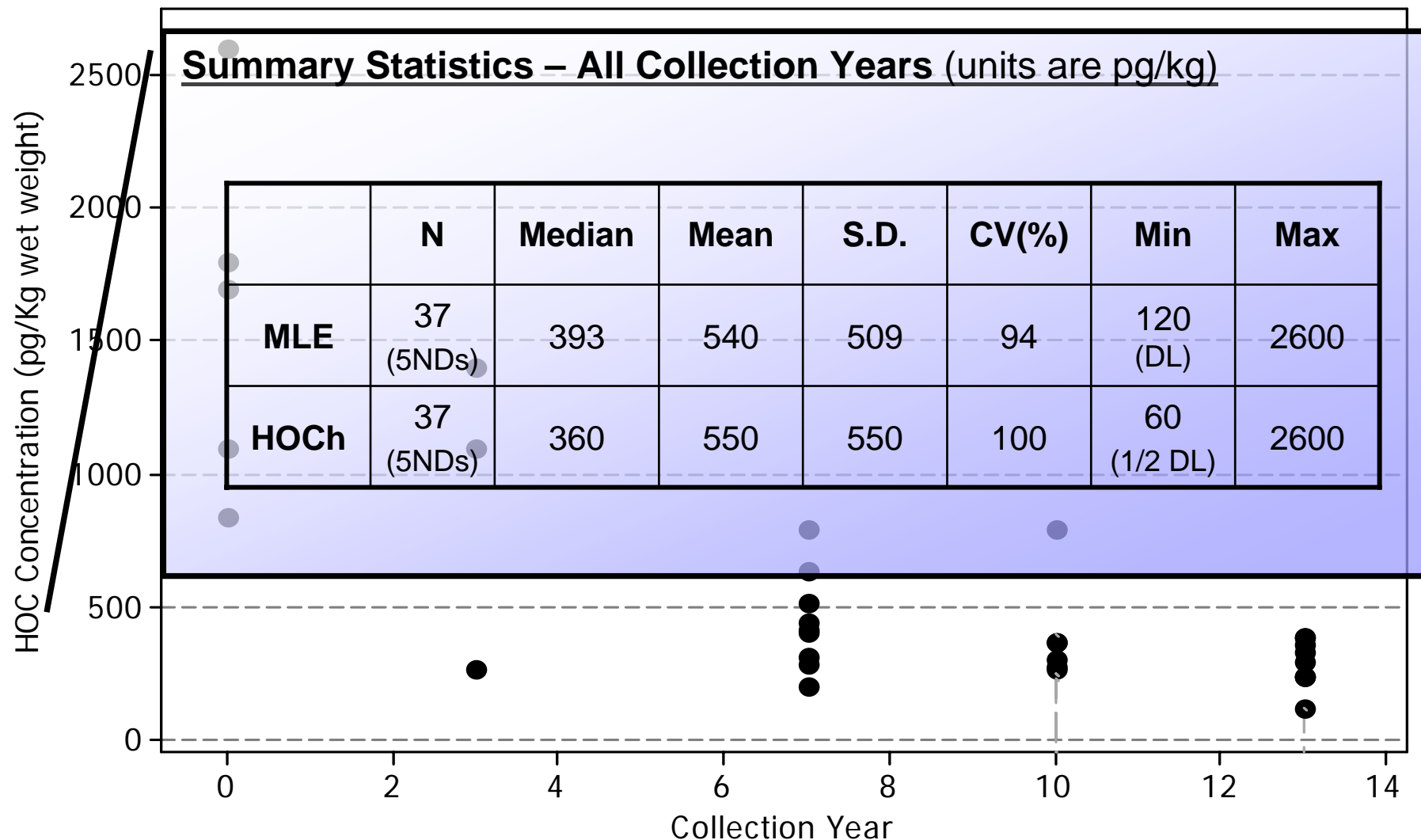
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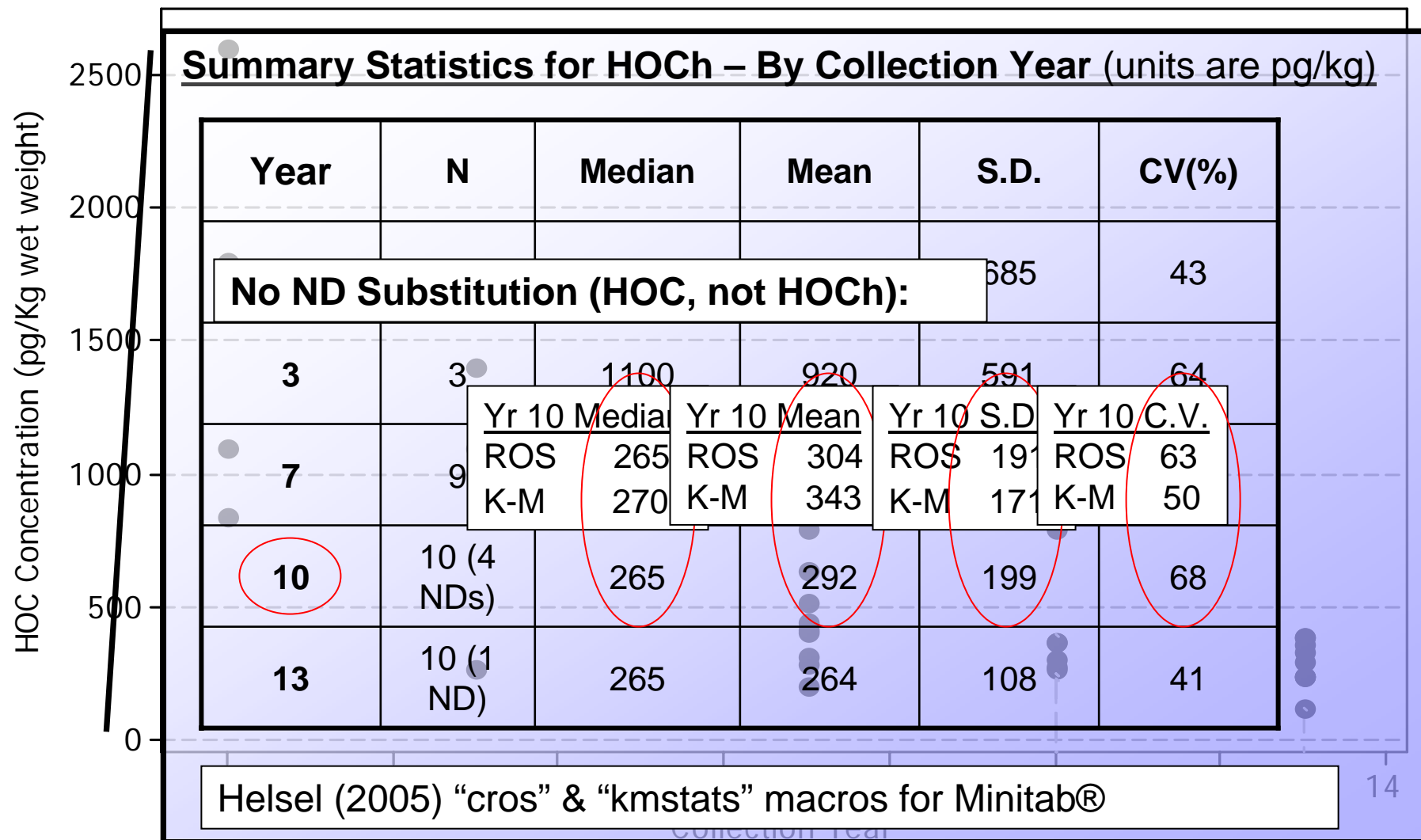
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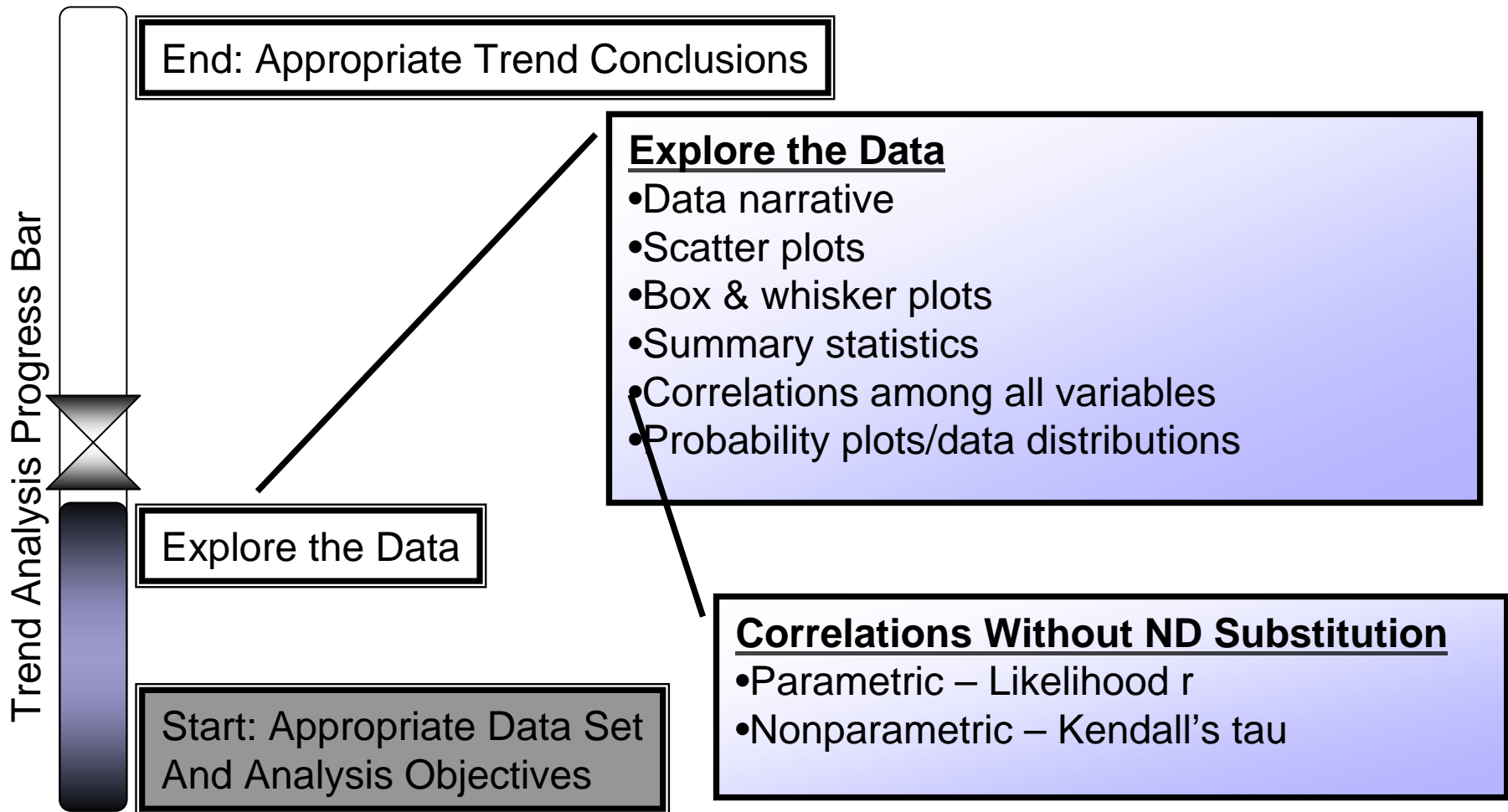
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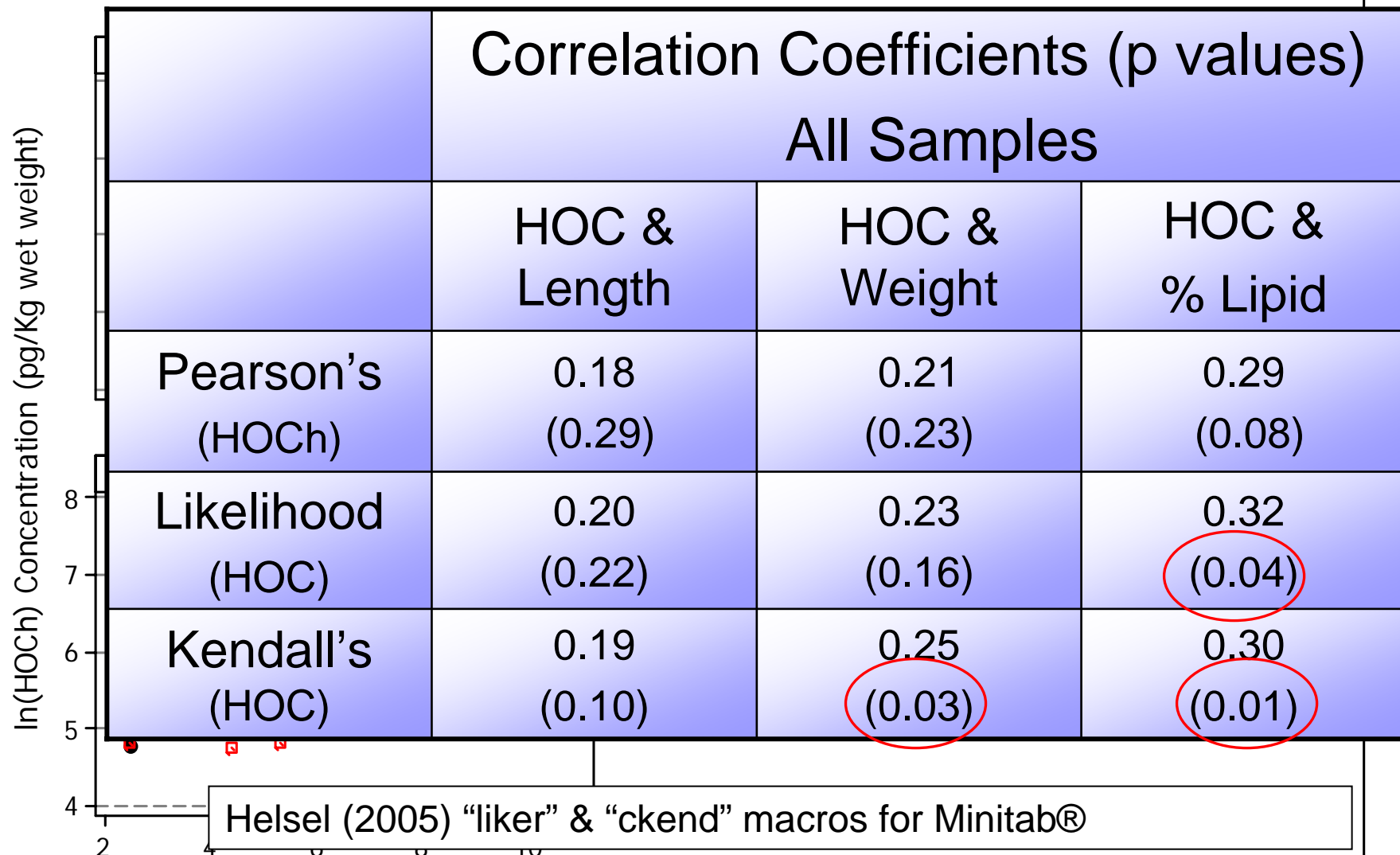
# Trend Analysis Data Exploration



# Trend Analysis-Data Exploration



# Trend Analysis Data Exploration-Correlation

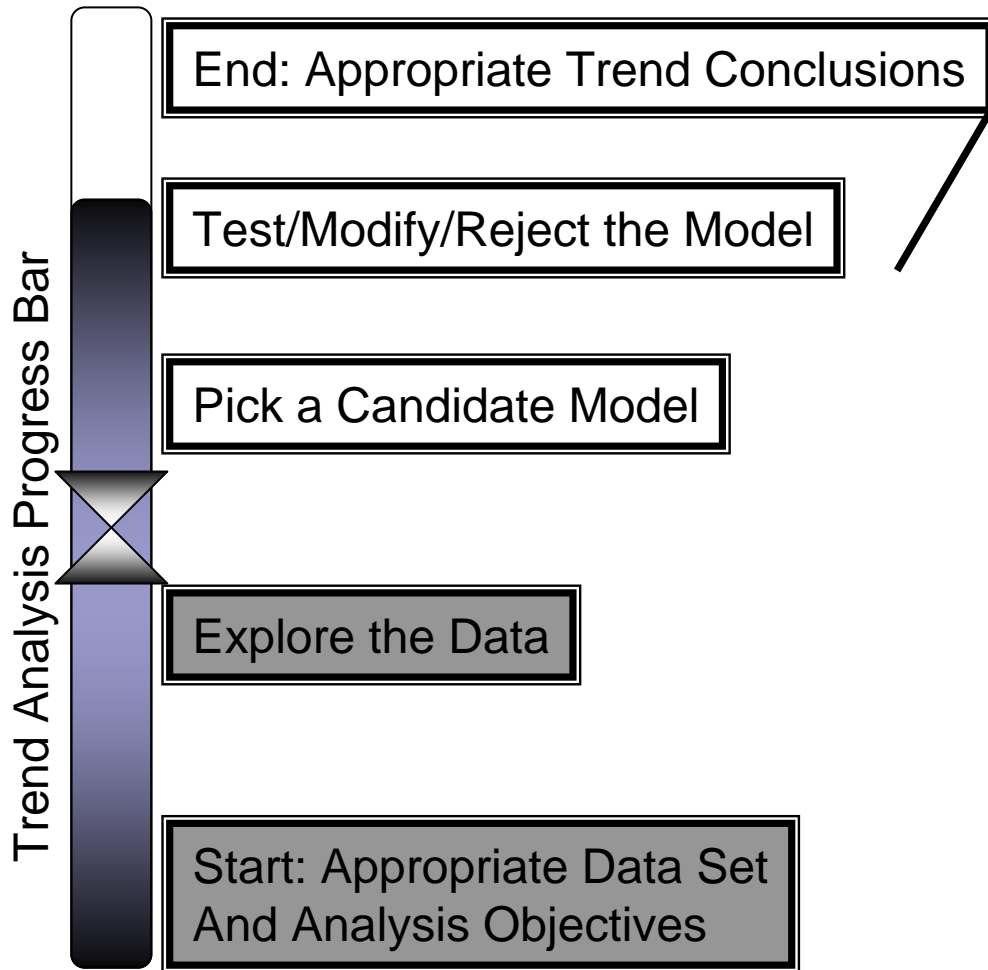


# Trend Analysis Data Exploration-Correlation

	Correlation Coefficients (p values) Without Year 13 "Outlier"		
	HOC & Length	HOC & Weight	HOC & % Lipid
Pearson's (HOCh)	0.33 (0.05)	0.40 (0.02)	0.51 (0.002)
Likelihood (HOC)	0.33 (0.04)	0.39 (0.01)	0.50 (0.001)
Kendall's (HOC)	0.25 (0.03)	0.31 (0.007)	0.36 (0.002)

Helsel (2005) "liker" & "ckend" macros for Minitab®

# Trend Analysis-Picking and Testing a Model



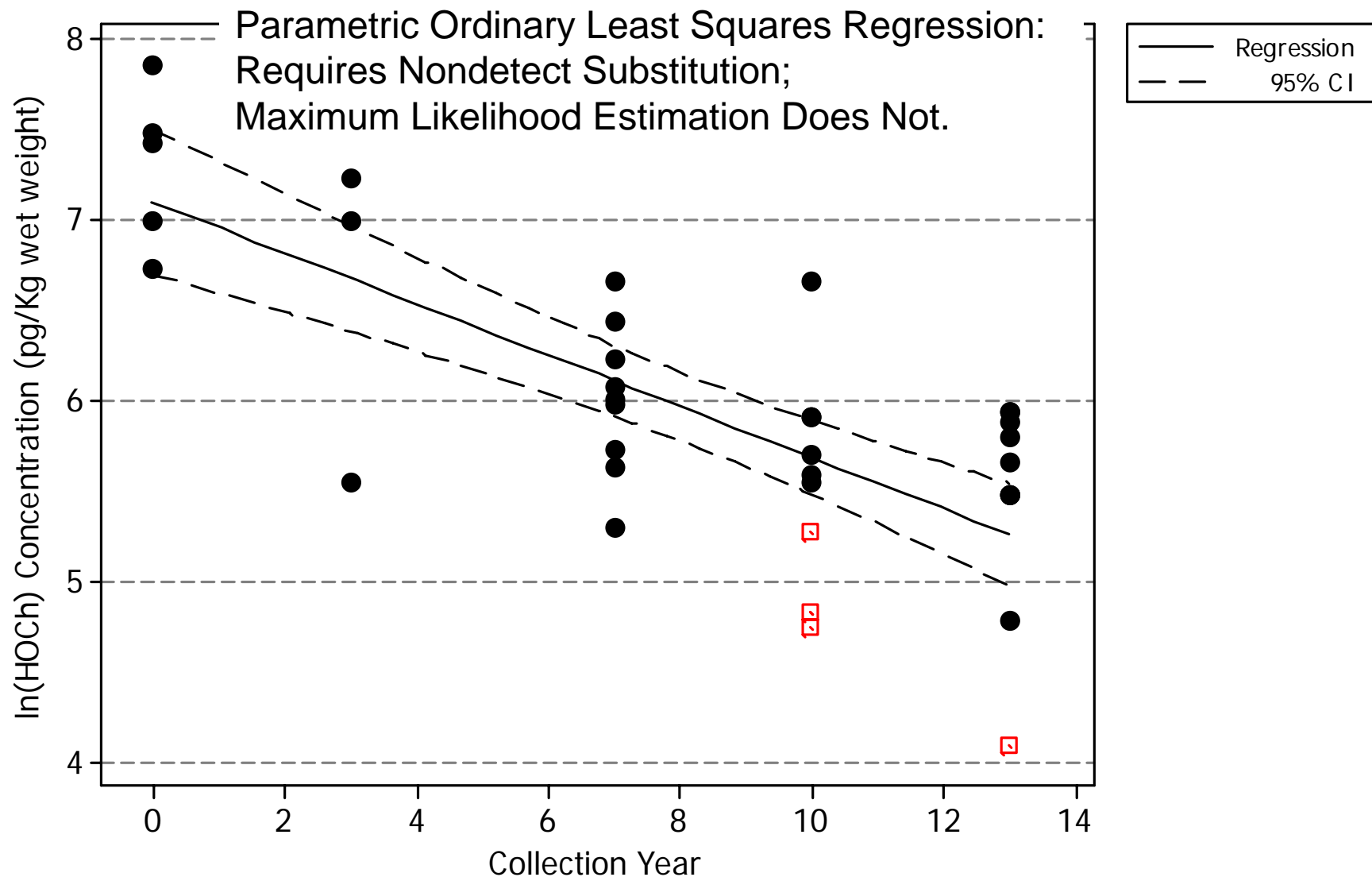
## **Pick and Test a Candidate**

**Model** (topic abbreviated for this presentation)

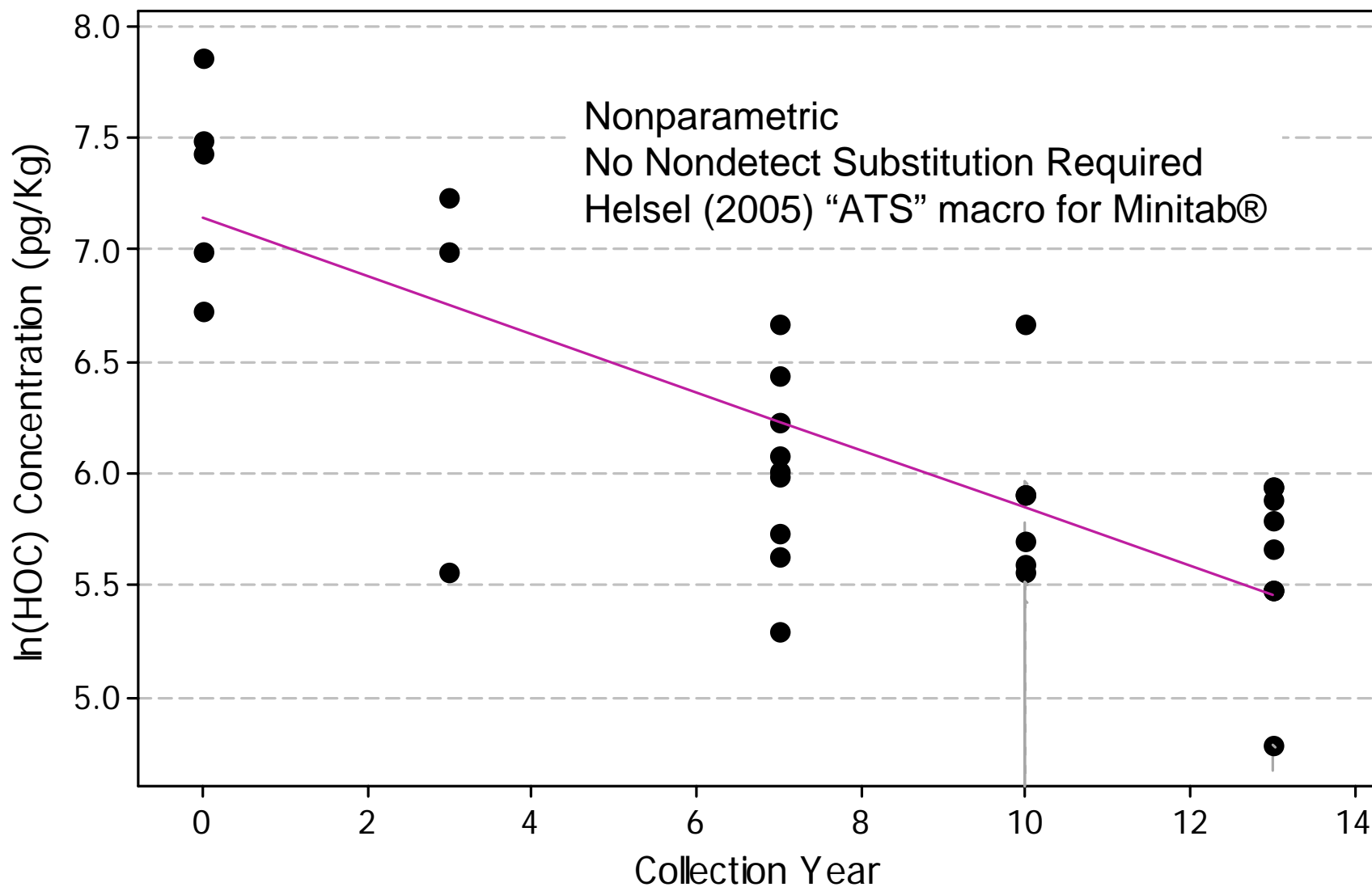
- All models are wrong...but some are useful...
- Keep it simple...
- First order exponential decay?
- Incorporate covariates?
- Evaluate residuals for normality, independence, equal variance if parametric model is used.



# First Order Exponential Decay Model

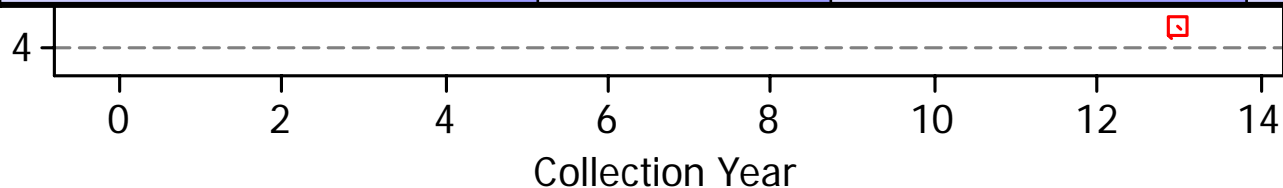


# Akritis-Theil-Sen Method



# First Order Exponential Decay Model Results

ln(HOCh) Concentration (pg/Kg wet weight)	Time to 50% Reduction (Years)			
	All Data			
	Median	95% LCL	95% UCL	
	Parametric			
	Simple OLS	4.9	3.7	7.1
	Simple MLE	5.1	4.0	7.2
	Nonparametric			
	ATS	5.3	Not determined	Not determined



# First Order Exponential Decay Model Results

ln(HOCh) Concentration (pg/Kg wet weight)	Time to 50% Reduction (Years) “Outlier Removed”			
	Median	95% LCL	95% UCL	
	Parametric			
	Multiple OLS (w/ weight & lipid)	6.1	4.6	9.1
	Multiple MLE (w/ weight & lipid)	6.2	4.8	8.8
	Nonparametric			
	ATS	5.8	Not determined	Not determined
Collection Year				
0      2      4      6      8      10      12      14				



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