

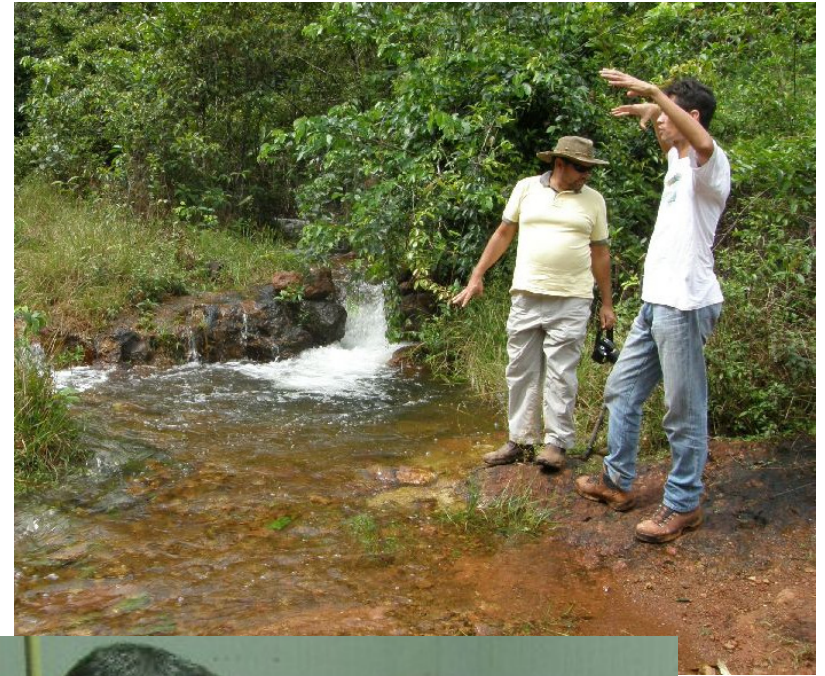
Overcoming uncertainties regarding  
newly discovered species resilience to  
habitat disturbance in the context of EIA

Jason Willey  
ERM, Inc.



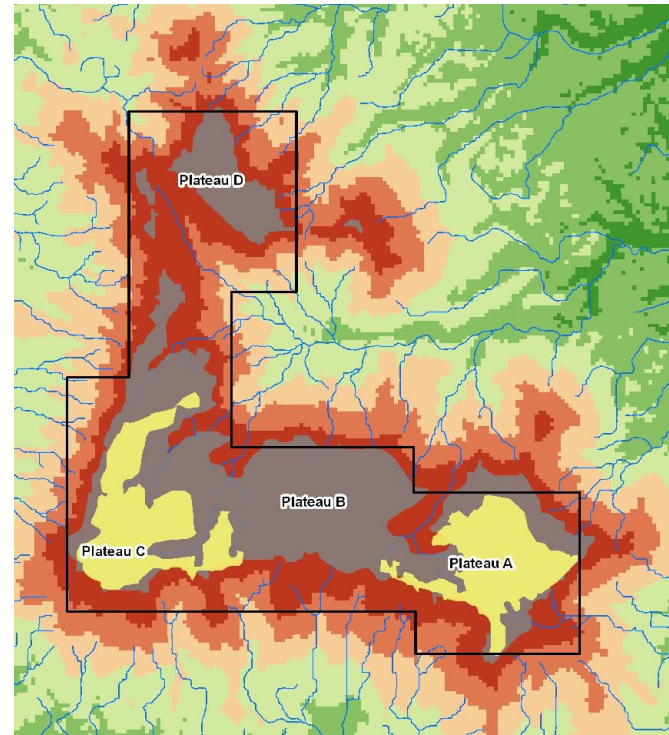
# The Issue

- Why do we care about uncertainty?
- Uncertainty in an ESIA affects all stakeholders adversely, but in different ways.
- So what to do about new-to-science species?



# Issue summary

- Proposed greenfield bauxite mine
- Catfish protection critical
- Very sparse data on catfish
- Turbidity is very low in all streams at Nassau
- Habitat requirements have been assumed to be existing conditions
- Are physiochemical conditions (water quality, habitat) limiting conditions for the Nassau catfish?
- What alternatives are available to reduce uncertainty?
- If they are limiting conditions, can surrogate species be used to assess their relationship to turbidity and stream conditions related to sedimentation (such as embeddedness and morphology)?



# Hypothesis

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Environmental surrogates will:

- be intolerant of environmental conditions that differ significantly from those on Nassau
- there would be an apparent threshold beyond which the surrogates did not occur.

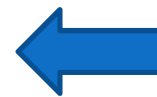
If true, then it is likely that the surrogates' tolerances are similar to the Nassau fishes' tolerances, and the surrogates can tell us enough to compensate for some uncertainty.

If not true, then the surrogates aren't instructive for our ESIA.



# The search for surrogates begins....

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Unnamed stream,  
Great Smoky Mountain  
National Park

Ijskreek,  
Nassau Plateau



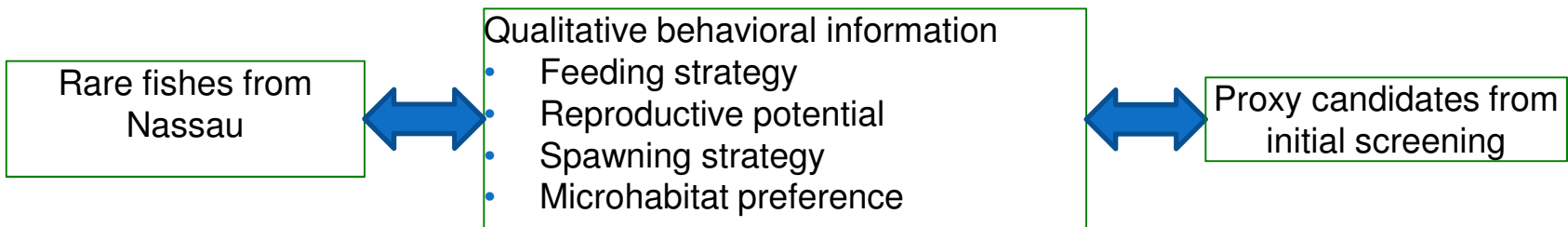
# Surrogate selection process

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Step 1. Initial screening identified ~ seven genera constituting about **120** species

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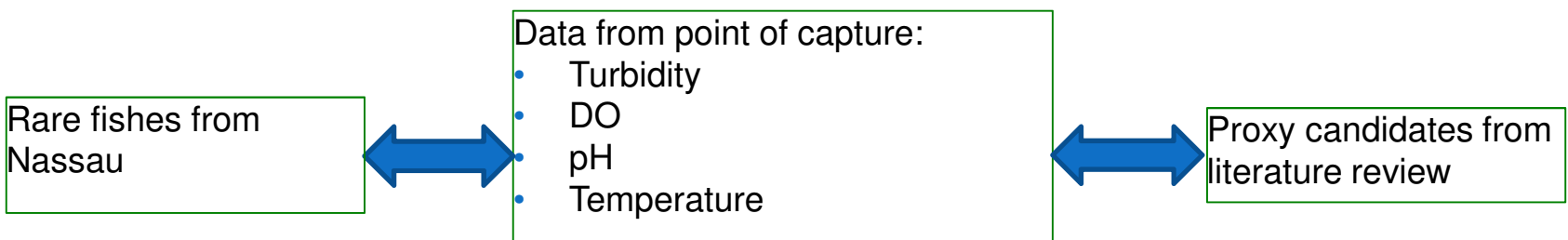
Step 2. Literature-based review



.....narrowed search to **20** species.

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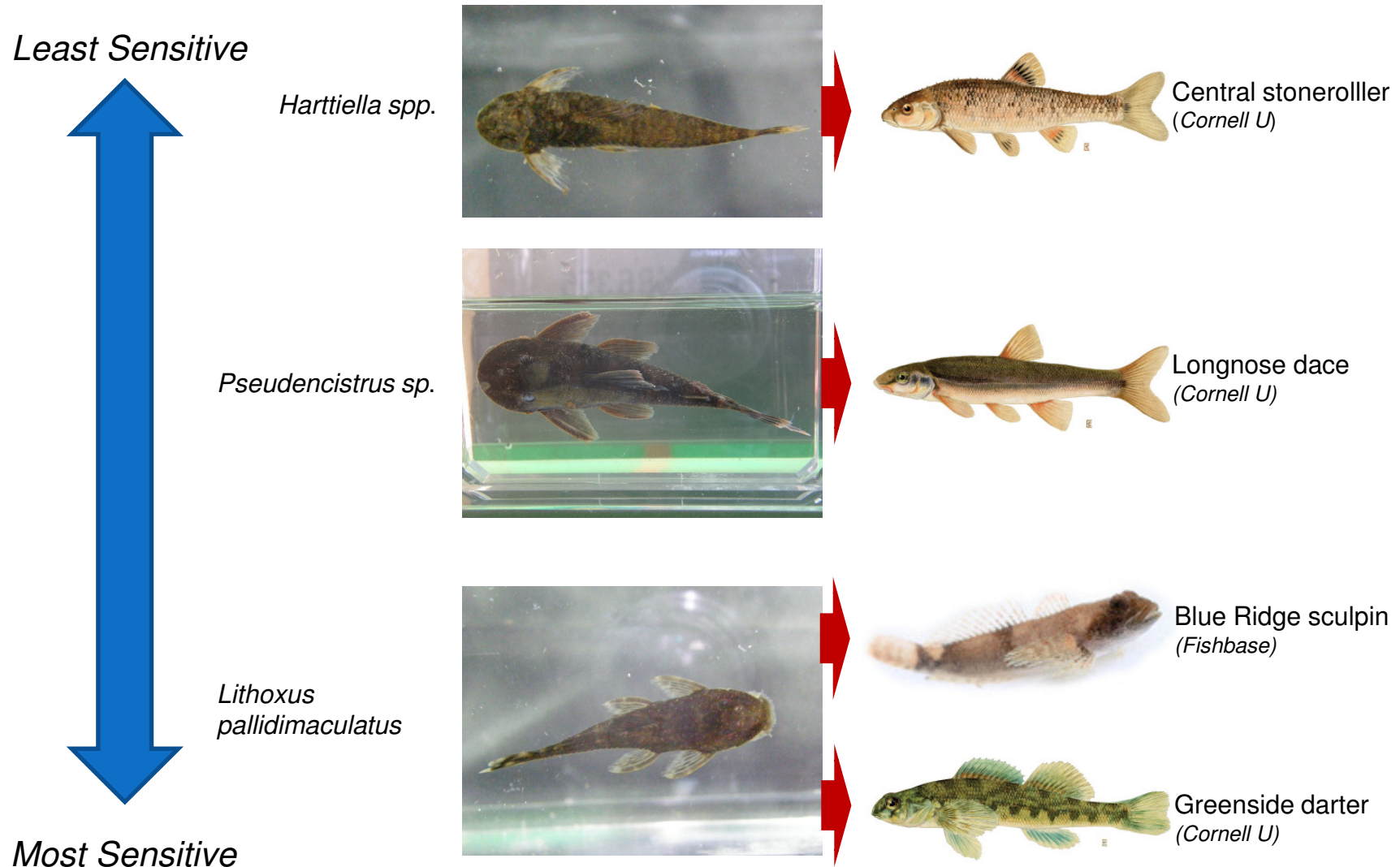
Step 3. Water quality-based approach



.....narrowed search to **4** species.

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# Comparison of Surrogates to Rare Species





# Water Quality and Abundance data

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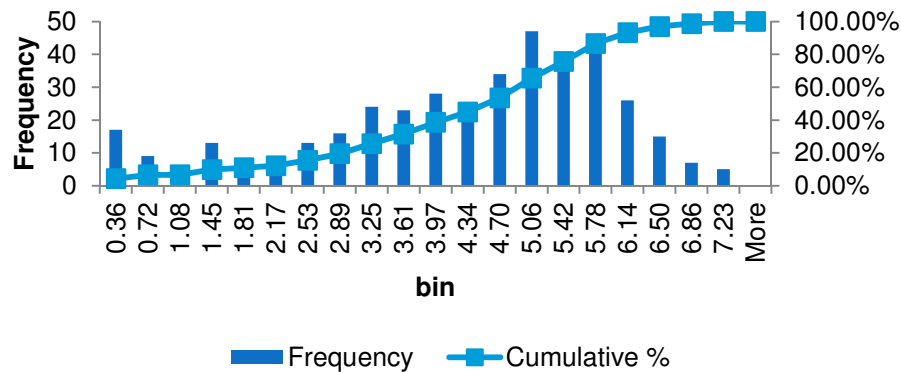
- Data sources and literature
  - MBSS
  - EMAP
  - Literature
- Data used
  - Species abundance at each sampling event
  - Water quality at sampling event



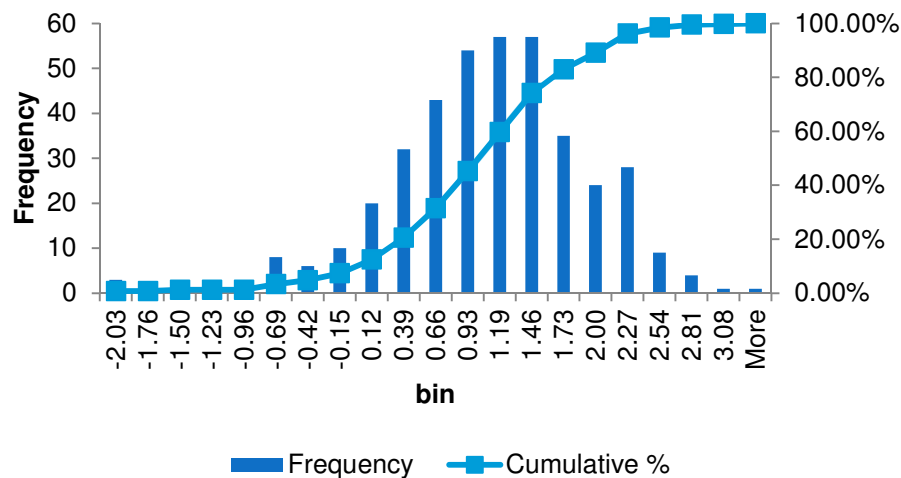


# For each species...

Blue Ridge Sculpin – Histogram  $\ln(\text{abundance})$



Blue Ridge Sculpin – Histogram  $\ln(\text{turbidity})$



- Evaluated range, mean, distribution etc for each physical and chemical habitat parameter (descriptive/diagnostic statistics)
- Evaluated relationships between abundance, abundance by catchment area, etc to different physical and chemical parameters
- Completed covariance and correlation assessments

# Presence/absence as a function of turbidity

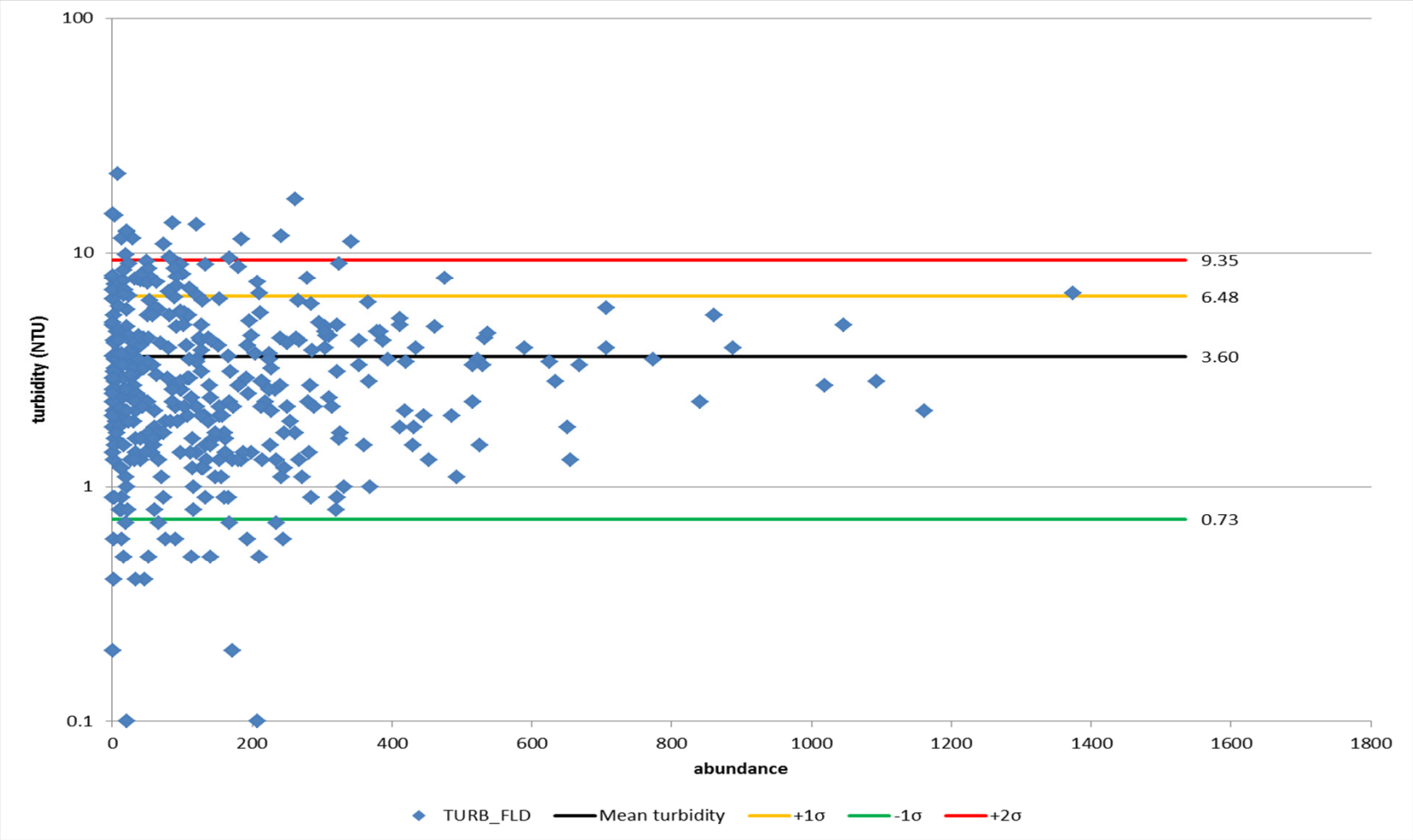


The first part of our hypothesis was that the surrogates would not be present in water quality much worse than what we find at Nassau

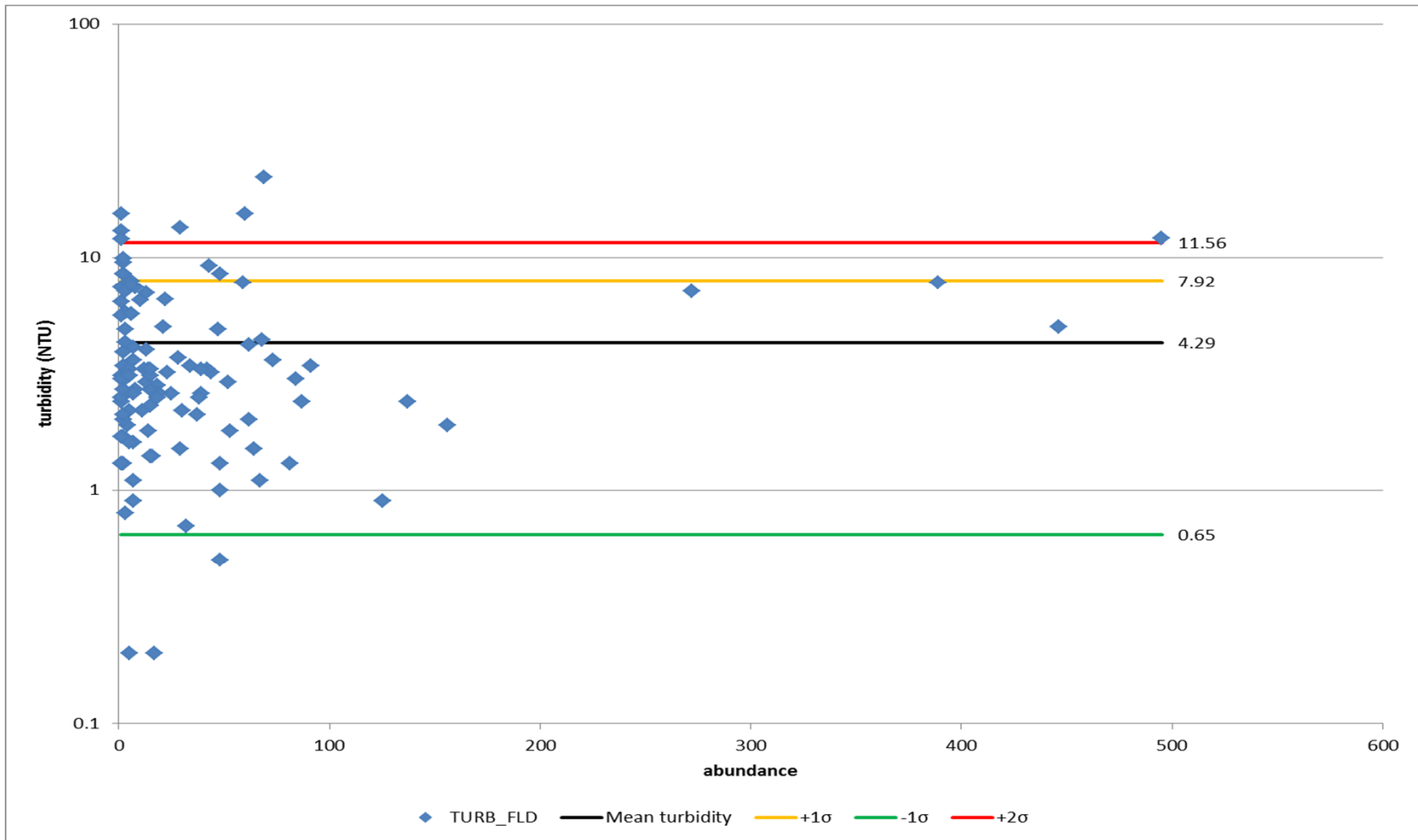
Turbidity at Nassau plateau averages roughly 5 to 10 NTU



# Blue ridge sculpin

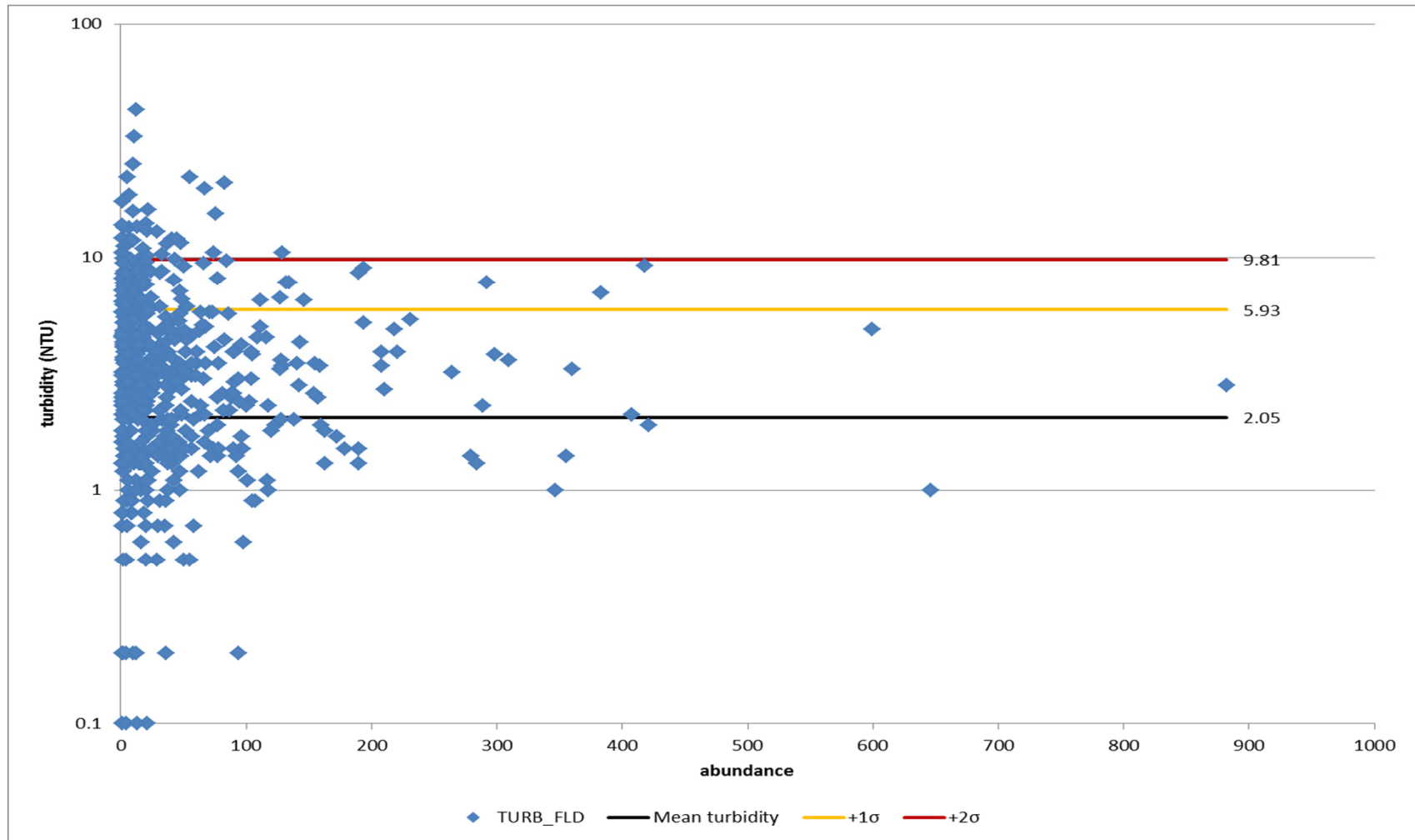


# Greenside darter

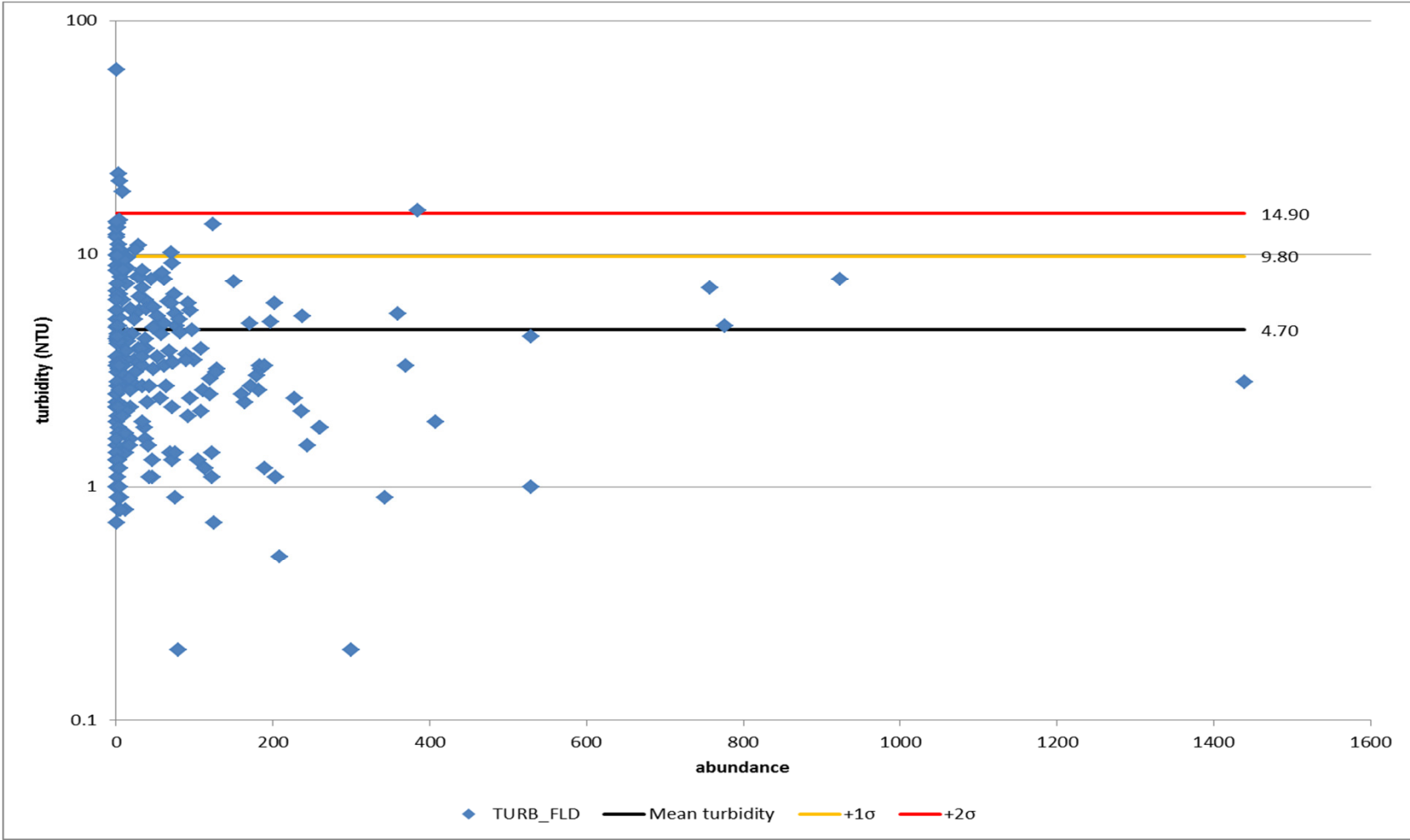




# Longnose dace

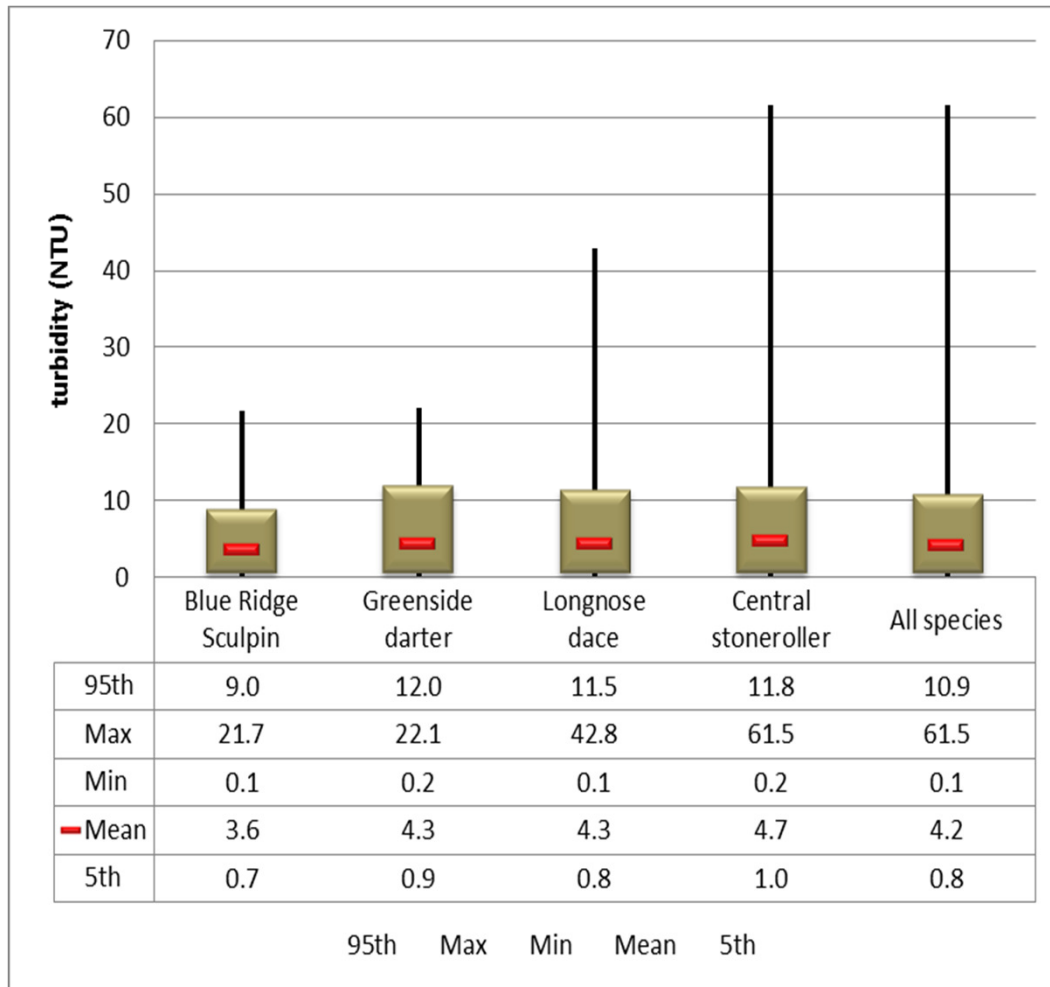


# Central stoneroller



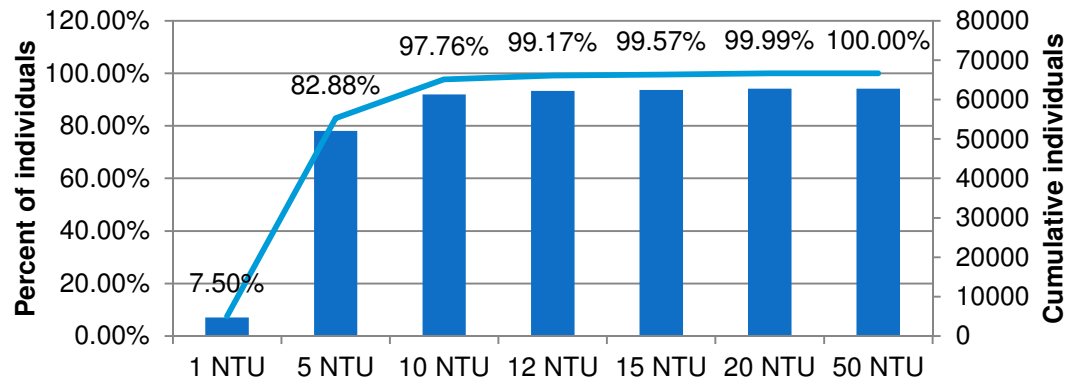


# Surrogates combined.....

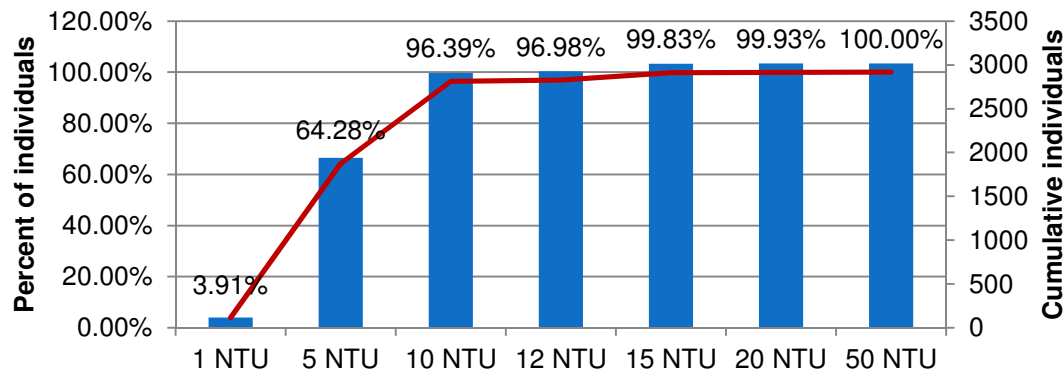


- First part of hypothesis is supported
- Surrogates generally limited to < 10 NTU
- Is there a “tipping point” for turbidity-sensitive fishes?

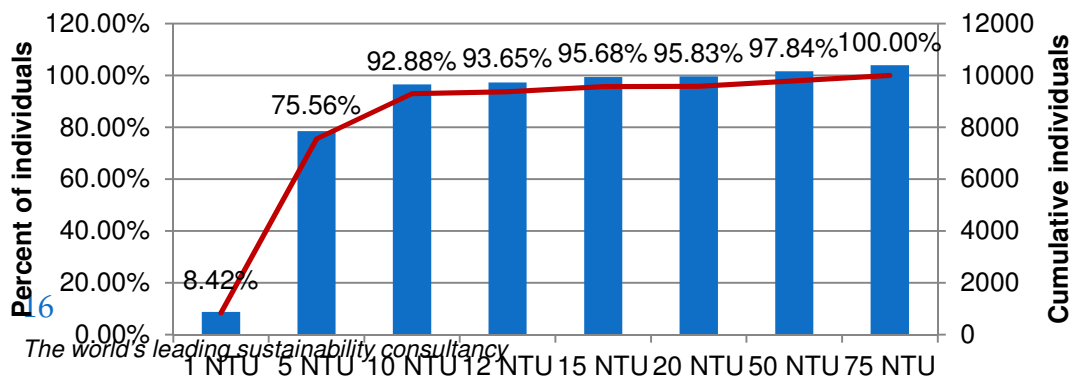
# Surrogate Cumulative Abundance vs. turbidity



- Nearly 98% of Blue Ridge sculpins found in waters <10 NTU
- <1% in waters >12 NTU



- More than 96% of Greenside darters found in waters <10 NTU
- <4% in waters >12 NTU



- Nearly 93% of Central Stonerollers found in waters <10 NTU
- <7% in waters >12 NTU

# Hypothetical assumptions fulfilled

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- ✓ Ecological surrogates will be intolerant of environmental conditions that differ significantly from those on Nassau

....and

- ✓ there would be an apparent threshold beyond which the surrogates did not occur.

# What this all means.....

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- The concept of using ecological surrogates is in fact a valid technique in ESIA
- This methodology can refine sensitivity analysis
- This method reduces the risk to lenders by providing quantitative analysis to accompany qualitative observation
- Provides a numerical, enforceable standard that is rooted in documented, biologically relevant requirements