A MULTI FACTOR INDEX TO DESCRIBE WATER QUALITY USING CONTINUOUS DATA IN THE DRB

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Goals of the index

- Provide the EnviroDYI network in the DRB with a simple but representative AND robust indicator of water quality conditions at their monitoring station.
- Facilitate the interpretation of continuous conductivity, temperature and turbidity data from the monitoring stations.

Goals of the presentation

- Share our ideas
- Get feedback from you:
  - Do you see this index as a useful tool?
  - Advantages and disadvantages

Disclaimer

- This is just a starting point, multiple iterations will be needed!
- Lot more work needed before a final product we are all happy with.

Example of report

- Prepared for individual stations
- Annual basis

Mock Annual Report
EnviroDIY monitoring network
Year 2021

Site: Muddy Creek
Code: MCCRD7
Coordinates: 39.868963, -75.772536
Group: Friends of Muddy Creek
Contact: Jane Smith

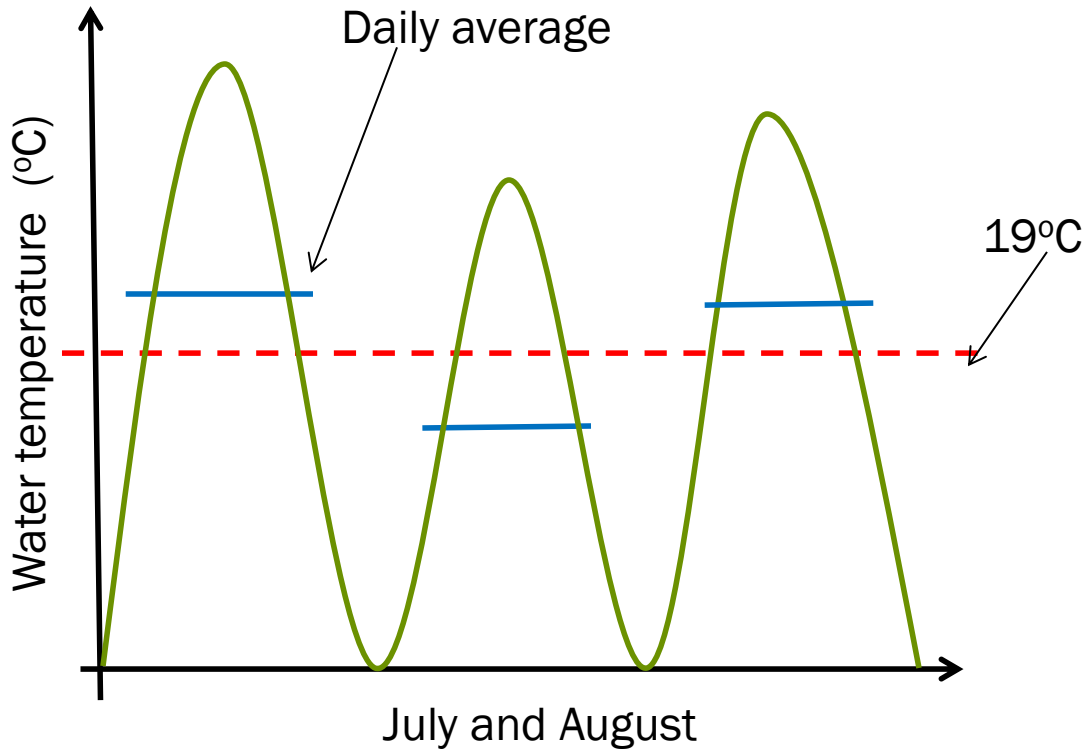
2021 statistics	Water temperature (°C)	Electric conductivity EC (µS/cm)	Turbidity (NTU)
Highest	25.6	2550	850
Lowest	1.3	350	5
Baseflow average	25.1	650	15
Stormflow average	15.3	1550	400
Overall average	19.5	715	100

Parameter	Indicator	Value	Ranking/41
Summer **temperature** exceedance	Fish habitat	50 days	**6**
Winter stormflow **EC** maxima	Road salt runoff	1000x	**20**
Summer baseflow **EC** exceedance	Groundwater salt contamination	2 days	**31**
Annual **turbidity** exceedance	Fish and invertebrate habitat	10 days	**39**
Overall index		????	

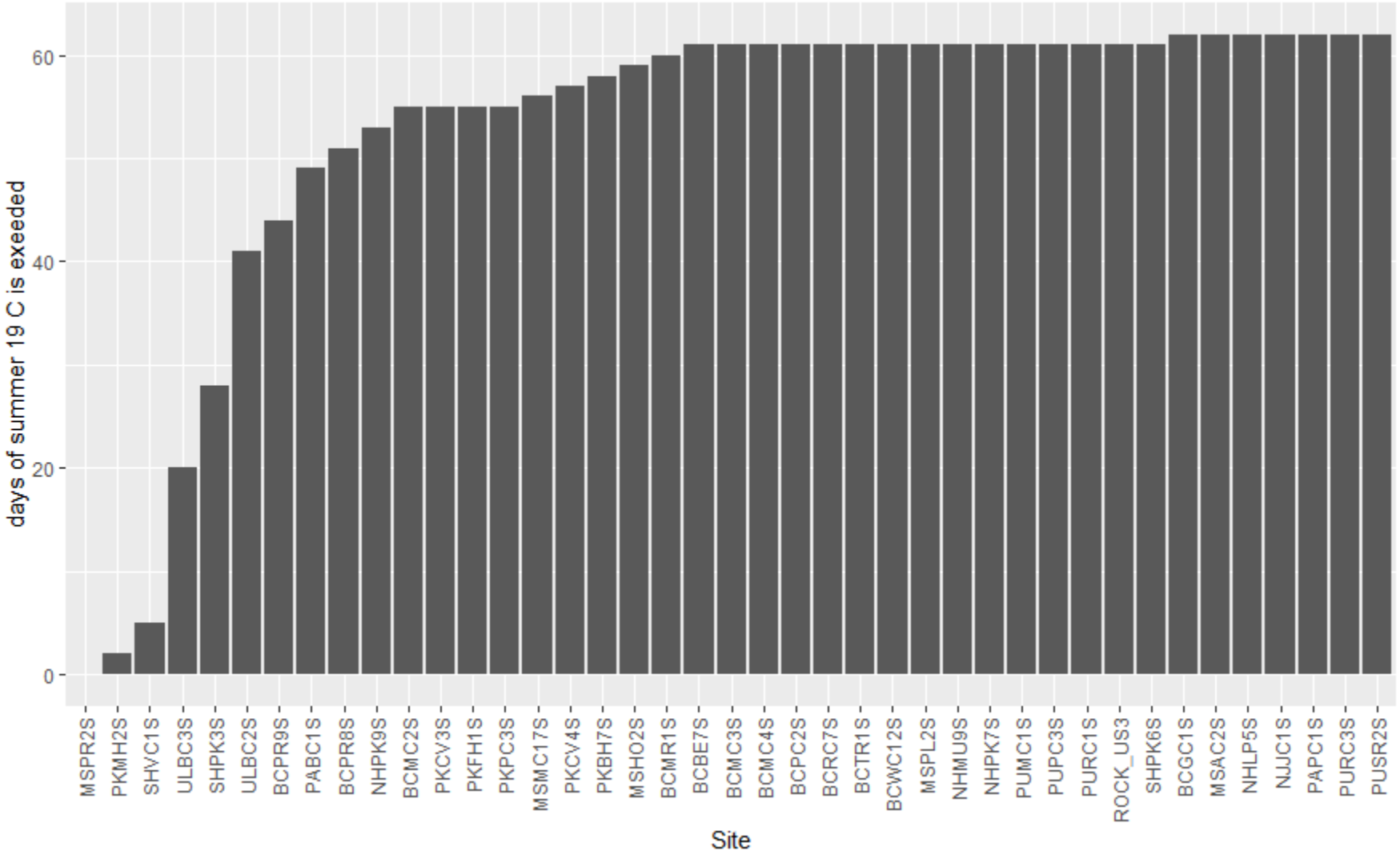
Number of summer days when temperature exceeds CWF threshold

- July and August
- Daily average
- Percent of the 60 days that the daily average exceeded 66 F or 19°C
- PA water quality standards

SYMBOL: CRITICAL USE: PERIOD	*TEMP$_1$ CWF*	*TEMP$_2$ WWF TEMPERATURE °F*	*TEMP$_3$ TSF*
January 1-31	38	40	40
February 1-29	38	40	40
March 1-31	42	46	46
April 1-15	48	52	52
April 16-30	52	58	58
May 1-15	54	64	64
May 16-31	58	72	68
June 1-15	60	80	70
June 16-30	64	84	72
July 1-31	66	87	74
August 1-15	66	87	80
August 16-30	66	87	87
September 1-15	64	84	84
September 16-30	60	78	78
October 1-15	54	72	72
October 16-31	50	66	66
November 1-15	46	58	58
November 16-30	42	50	50
December 1-31	40	42	42



Number of summer days 19C is exceeded



2020 data: 41 sites had over 70% of both winter and summer complete

Number of summer days at baseflow electric conductivity (EC) exceedance over modeled "natural EC"

- Summer: July and August
- Baseflow conditions
- Daily average
- EPA Model: specific for each stream

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Article

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Modeling Spatial and Temporal Variation in Natural Background Specific Conductivity

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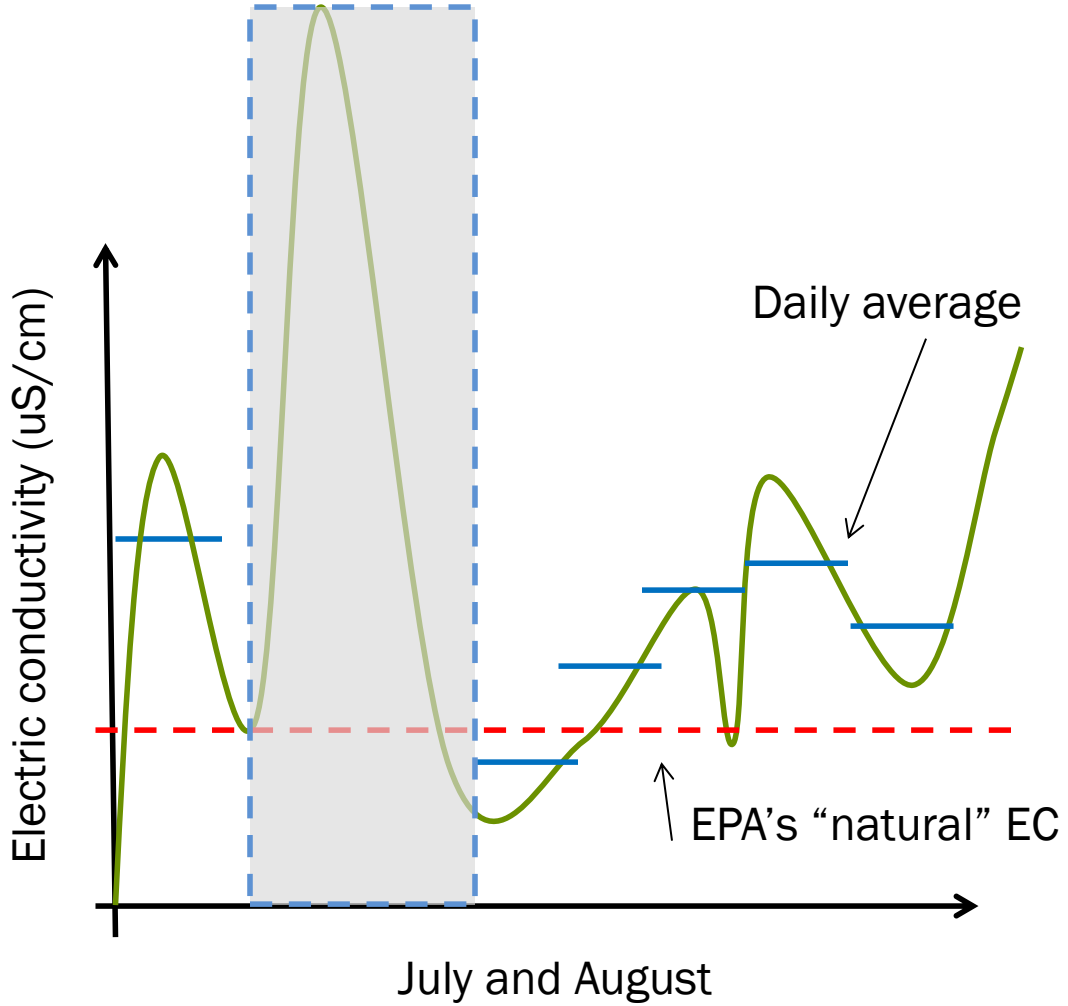
‡U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, 26 Martin Luther King Drive West, Cincinnati, Ohio 45268, United States



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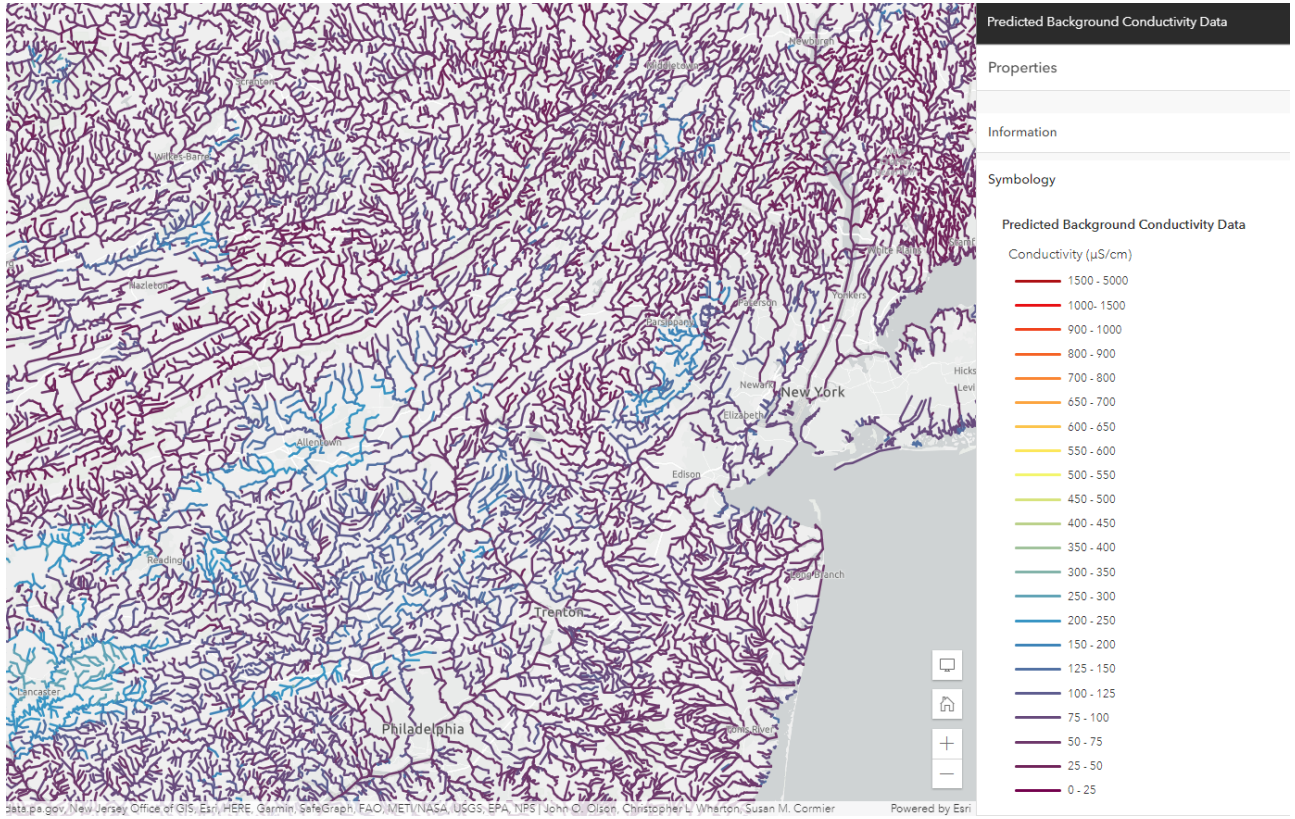
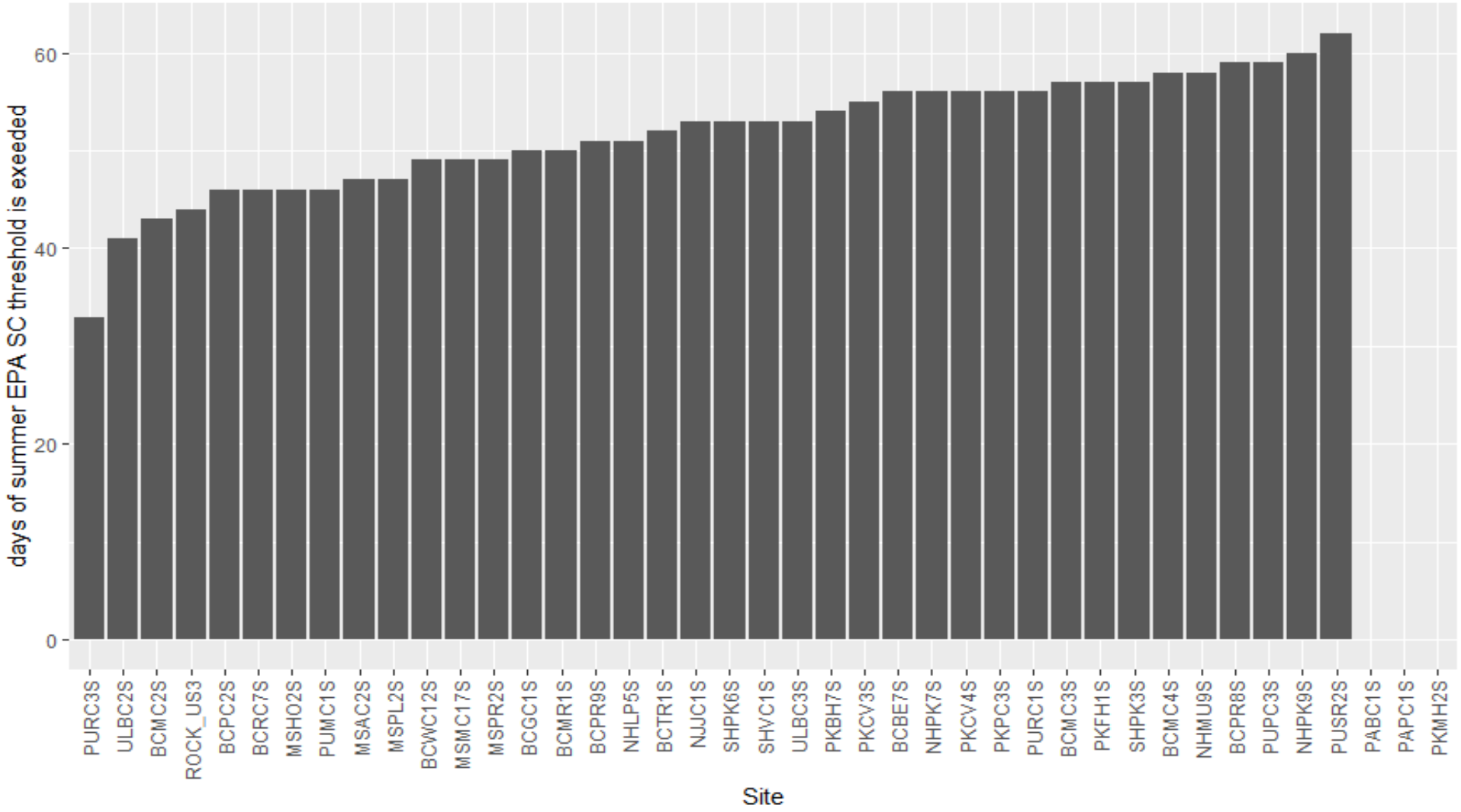
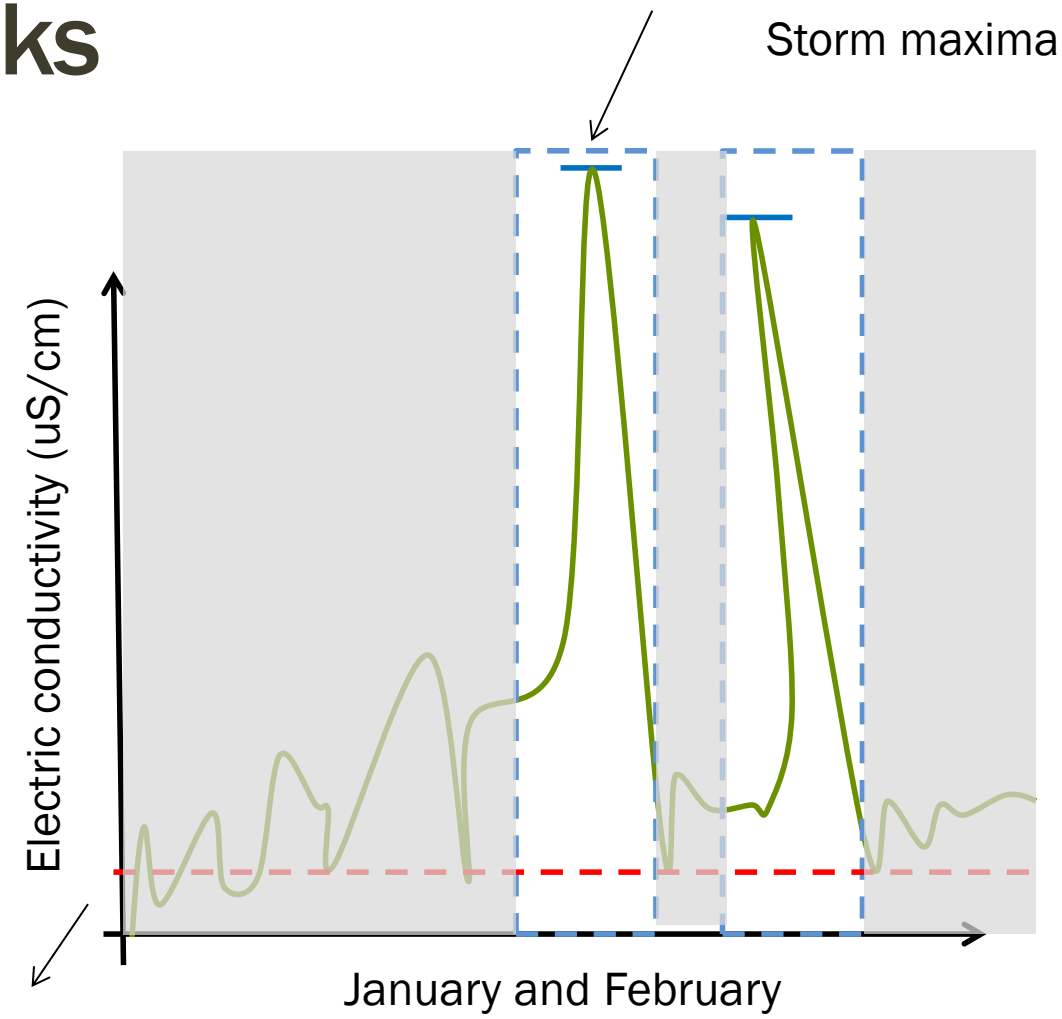


Summer days at baseflow EC exceeded EPA modeled "natural EC"

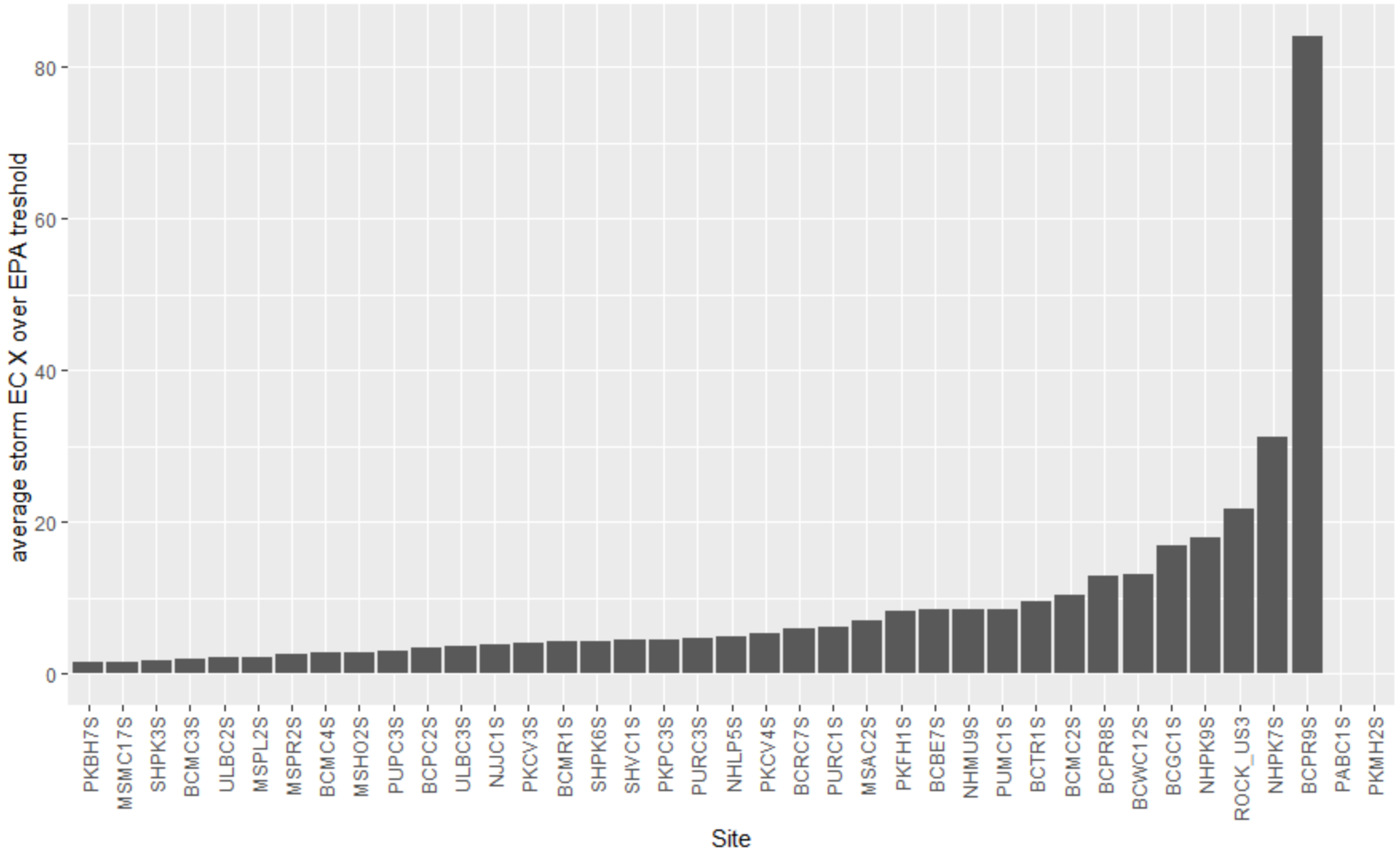


Magnitude of winter EC peaks

- Winter: January and February
- Within a storm event
- Averaged maxima
- How many times (x) higher than EPA threshold

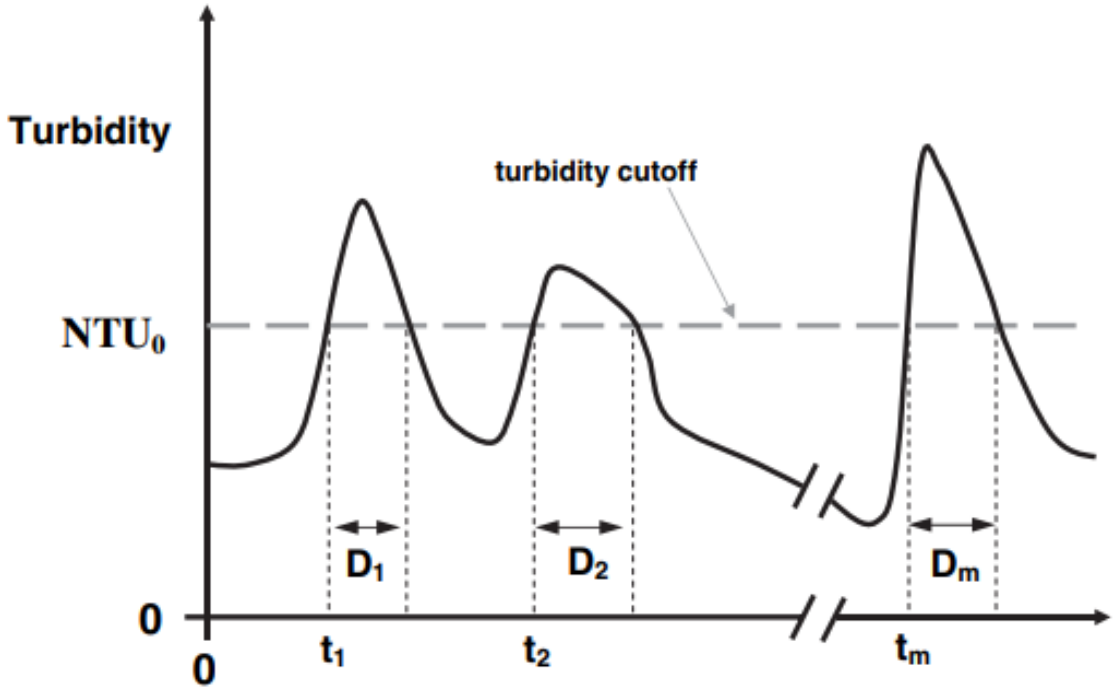


Average winter storms X over the EPA EC threshold

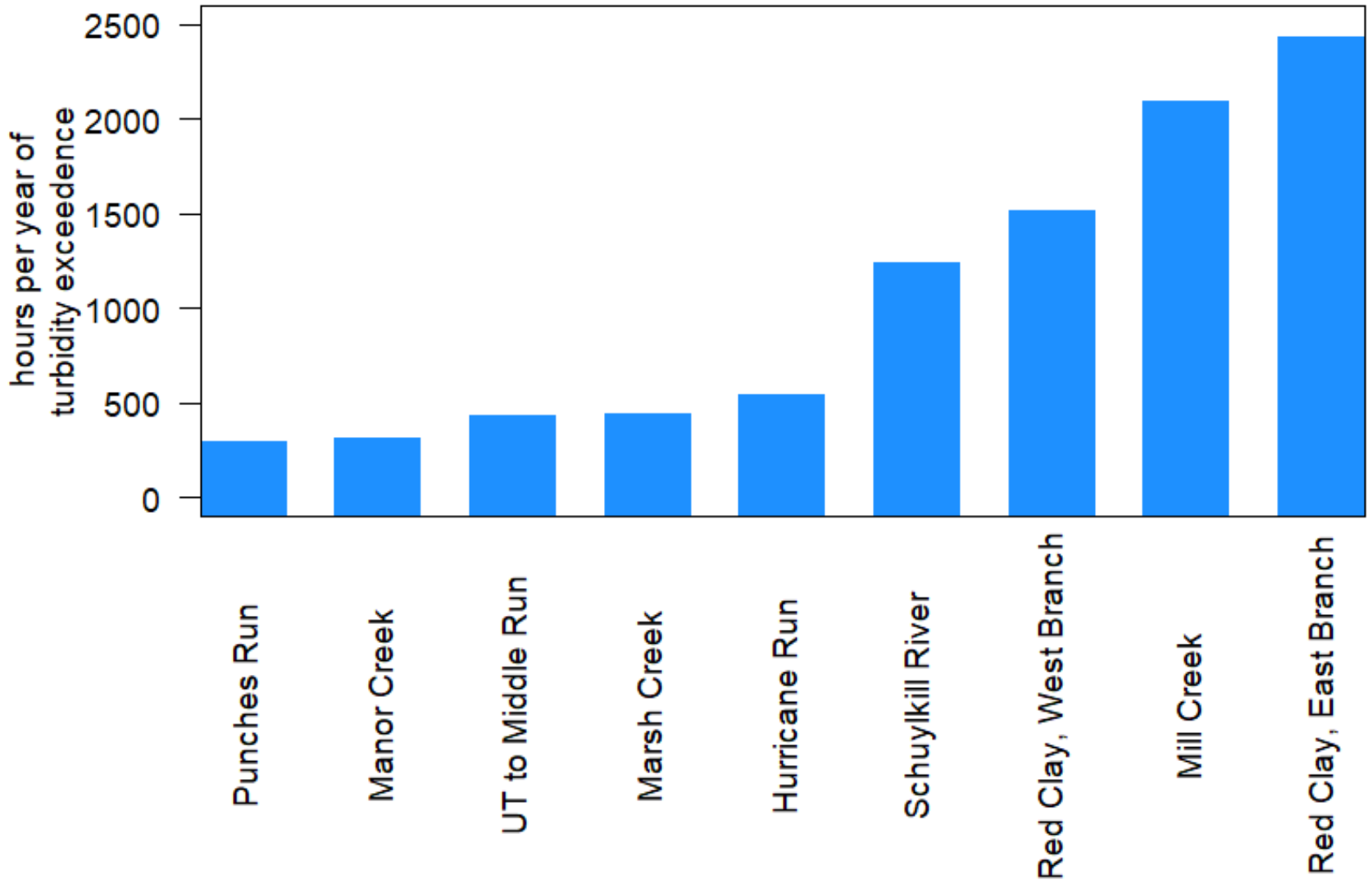


Duration of turbidity exceedance over biological thresholds

- Seven turbidity-duration thresholds with biological impact from the literature for fish species in eastern US
- Two were found in the literature for invertebrates
- Sum of all exceedances per year for these nine thresholds



Turbidity threshold-duration exceedances using all available QC'd data



Next steps

- Still zeroing on details for each parameter
- Modifications to each parameter
  - For example
    - 16ºC vs 19ºC vs 21ºC
- How to standardize and “add” all the parameters?

Thank you!

Questions?

Citation	Effect	NTU	Duration	Region	Notes
EPA 2008 Propsed turbidity rule	unspecified	13	1 day	US	
Strand and Merrit 1997	Hydropsyche betteni survival reduced from 90% to 60%	23	6 hr/day for 16 days	Michigan	0.25 days X 16 days = 4 days
Shaw and Richardson 2001 Direct and indirect effects of sediment pulse duration on stream invertebrate assemblages and rainbow trout growth and survivial	rainbow trout fry decreased mass and length growth rate	23	6 hr/day every other day for 19 days	British Columbia	0.25 X 9 days = 2.25 days
Ljunggren and Sandstrom 2007 Influence of visual conditions on foraging and growth of juvenile fishes with dissimilar sensor physiology	specific growth rate of perch (perca fluviatilis) was reduced	25	4 days	Europe	
Sweka and Hartman 2001 Effects of turbidity on prey consumption and growth in brook trout	62% decrease in specific growth rate brook trout	40	5 days	West Virginia	
Sutherland and Meyer 2007 Effects of increased suspended sediment on growth rate and gill condition of two southern Appalachian minnows	growth rate of whitetail shiners and spotfin chubs is reduced	46 (shiners) 26 (chubs)	21 days	North Carolina	
Shoup and Wahl 2009 Effects of turbidity on prey selection by piscivorous largemouth bass	Large mouth bass foraging rate declines 100-fold	40	55 hours		2.3 days
Shaw and Richardson 2001 Direct and indirect effects of sediment pulse duration on stream invertebrate assemblages and rainbow trout growth and survivial	invertebrate drift increased and benthic abundance decrease	23	3 hr pulse every other day for 9 days	British Columbia	3 hr X 4 days = 12 hours