Notes on Modeling Periphyton

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Issue: How to compare periphyton target and measured data with AQUATOX model results

Model Representation

The following is an excerpt from Supporting Information provided to the AQUATOX Workgroup by Dick Park (May 7, 2013)

> AQUATOX is an ecosystem model that simulates all biotic and abiotic constituents in each riverine reach. It is required to maintain mass balance, accounting for all changes in concentrations of nutrients, algae, invertebrates, and fish. Its application cannot be restricted to only one part of a reach such as a riffle. Park and Clough (2012)
>
> So implementation of the model requires that it represent average conditions for an entire reach. However, being averaged across habitats would be misleading for application in criteria analysis.
>
> The solution is to deconstruct the simulation results by saving the output to Excel and reversing the calculations used in normalizing the data.

Diagram of gravel in a riffle

For the Boise River, data are collected on gravel in a riffle.

- Data are collected on gravel in a ruffle section of the River (Attachment A).
- Each reach of the river is model as a percentage of Pool, Run and Reach (Attachment B)

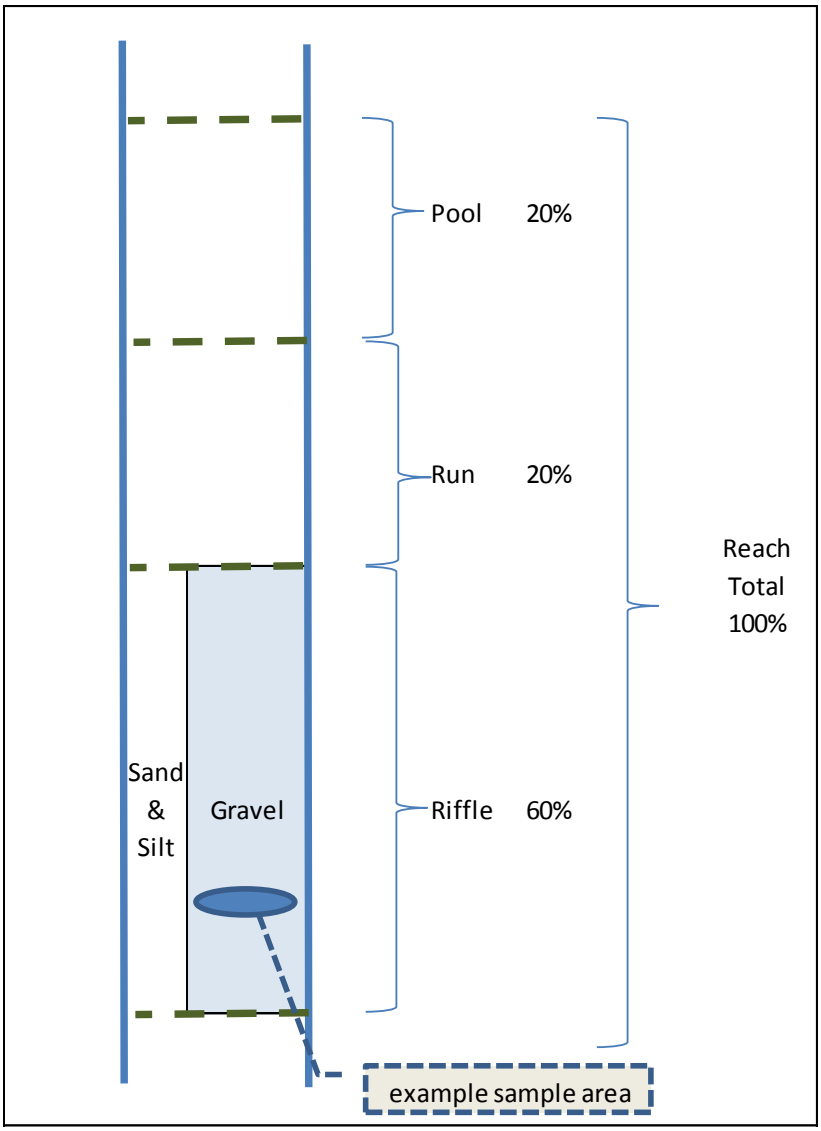


Figure – Example of river reach with sand, silt and gravel substrate in a riffle section of a reach.

Example Normalization and Deconstruction

A model represents average conditions in a river "reach". The reach as pools, runs and riffles. A riffle can have gravel area that grows periphyton and sand/silt areas that do not. Thus, there needs to be a 2-step process to normalize measured data or deconstruct model results: Step 1 for % Gravel, and Step 2 for % Riffle

Table A Normalizing Measure Data and Deconstructing Model Results

	Example	
	A	B
Measured Data		
Measured Periphyton on Gravel (avg)	94	158
Percent Greater than Sand/Silt	81%	81%
Data Normalization (to use "in" model)		
Step 1 - Riffle Normalization		
% Gravel	81%	81%
Periphyton in Riffle	76	128
Setp 2 - Reach Normalization		
% Riffle	80%	80%
Periphyton in Reach	61	102
Combined Riffle/Reach		
Riffle/Reach Normalization	65%	65%
Normalized Periphyton	61	102
Deconstructing Model Results		
Ex. Modeled Value (Avg for Riffle/Reach)	**50**	**90**
Riffle/Reach Normalization	**65%**	**65%**
Deconstructed Periphyton	**77**	**139**
Target	**150**	**150**
Normalized Target (if used "in" model)	97	97

The examples show how measured data would be used in the model to compare directly with simulation results. Or, how model simulation results would be "deconstructed" (e.g., post-processed in Excel) to compare with data or a periphyton target. It appears that this "two-step process" goes a step further than the approach discussed by Tom Dupuis (Attachment A – only has Step 1), but is consistent with model setup (Attachment B) and the "mockup" by Ben Cope (Attachment C).

Attachment A

On 4/29/2013 Tom Dupuis wrote:

"Attached is the pebble count data that was used to normalize the measured periphyton data, this is the same data that showed on the screen in the last modeling meeting. On the "Overall Summary" sheet I've added an example of how the pebble counts were used to normalized measured data, namely, the fraction of the reach that was greater than sand and silt was simply multiplied by the measured data. For example, at Eckert, the measured value for this example event was 94 mg/m2, and 81% of the site was greater than sand and gravel, and so the normalized value was 81% of the measured value, or 76 mg/m2."

Pebble Count		Eckert Rd	Glenwood	Middleton	Ft Boise WMA
Mean % size class		11/18/1997	2/27/1995	11/24/1997	1/26/1998
Mean % very large boulders	4096-2048 mm	0.00	0.00	0.98	0.00
Mean % large boulders	2047-1024 mm	0.00	0.00	0.00	0.00
Mean % medium boulders	1023-512 mm	0.00	0.00	0.00	0.00
Mean % small boulders	511-256 mm	1.68	0.62	0.00	0.00
Mean % large cobbles	255-128 mm	36.44	14.27	2.00	0.69
Mean % small cobbles	127-64 mm	29.10	33.91	14.43	7.59
Mean % very coarse gravel	63-32 mm	8.88	20.25	17.54	19.07
Mean % coarse gravel	31-16 mm	3.34	4.11	9.13	16.96
Mean % medium gravel	15-8 mm	1.45	5.83	5.36	8.70
Mean % fine gravel	7.9-4 mm	0.27	0.00	2.08	0.79
Mean % very fine gravel	3.9-2 mm	0.00	0.00	5.48	0.00
Mean % sand	1.9-0.062 mm	18.84	21.03	38.40	29.80
Mean % silt	<.062	0.00	0.00	4.61	16.41
% substrate greater than sand and silt		81	79	57	54
chl a (mg/m2) measured in Oct. 2005 in *riffles*		94	158	93	162
chl a (mg/m2) for *reach* (normalized by pebble count)		76	125	53	87
deconstructed chl a (mg/m2) for riffles		94	158	93	162

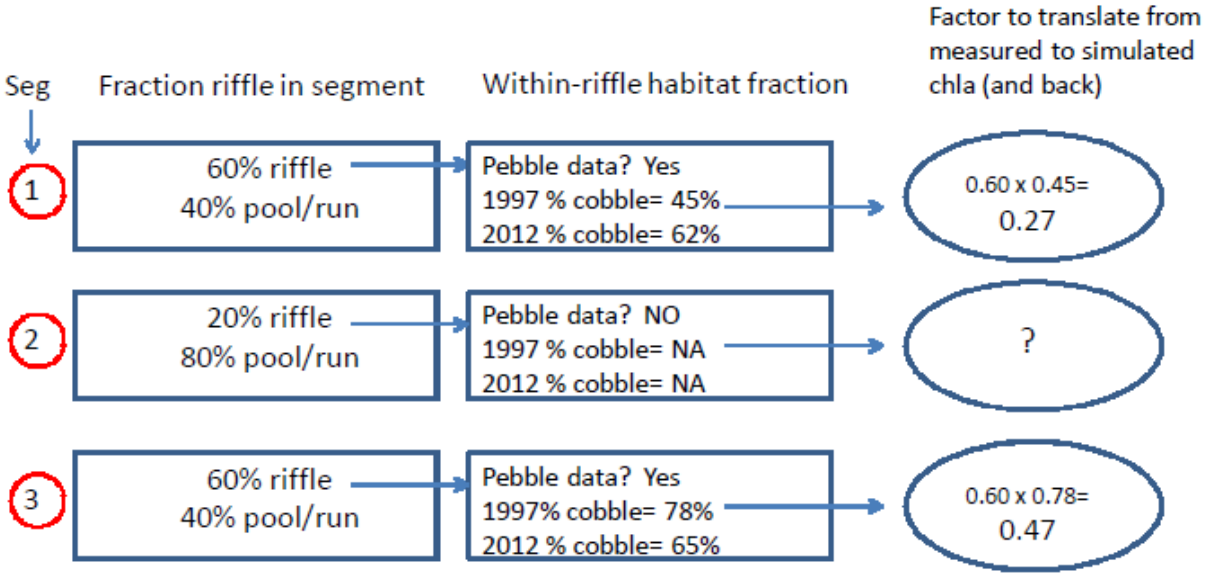
Attachment B

Tables of Parameters for "4 segment Model" (per summary by K Harris)

Stream Parameters	**Eckert**	**Glenwood**	**Middleton**	**Parma**	***Units***
Channel Slope	0.002036	0.002	0.002	0.002	*m/m*
Maximum Channel Depth Before Flooding	1.5	5	1.5	1.5	*m*
Sediment Depth	0.1	0.1	0.1	0.1	*m*
Manning's Coefficient					
Estimate based on stream type	natural stream	natural stream	natural stream		
or use value below				0.05	*s/m^1/3*
River Habitats Represented					
Percent Riffle	80	80	43	55	*%*
Percent Pool	0	0	0	0	*%*
Percent Run	20	20	57	45	*%*

Site Data	**Eckert**	**Glenwood**	**Middleton**	**Parma**	***Units***
Max Length (or reach)	5	5	5	5	*km*
Volume	1.20E+05	1.39E+05	7.56E+04	1.89E+05	*m3*
Average depth (note for volume calc)	0.32	0.82	0.42	0.82	*m*
Surface Area	3.74E+05	1.70E+05	1.80E+05	2.30E+05	*m2*
Average width (note for surface area calc)	75	34	36	46	*m*
Mean Depth	0.74	0.82	0.42	0.6	*m*
Maximum Depth	1.00	1.82	0.63	1.00	*m*
Average Temperature	11	11	11	12.7	*C*
Temperature Range	18	18	18	15.4	*C*

Attachment B – "Mockup" example by Ben Cope



Example diagram and calculation provided in File "Reach habitat info mockup epa.pptx"