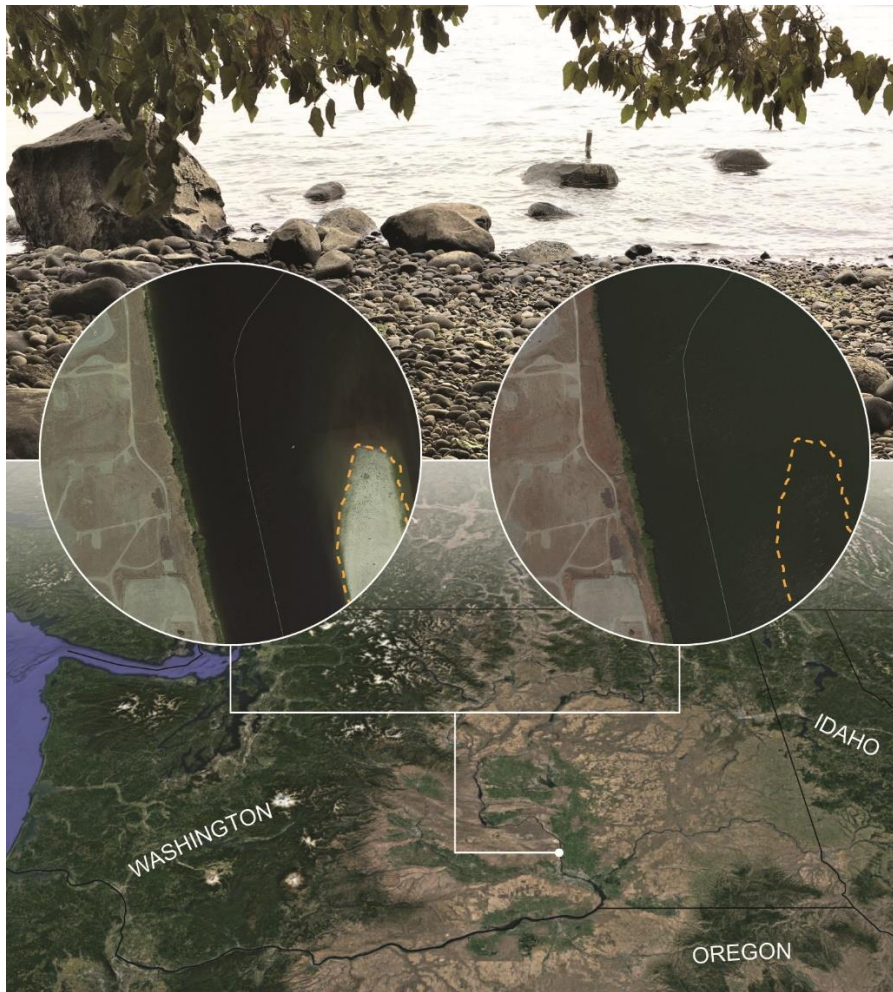
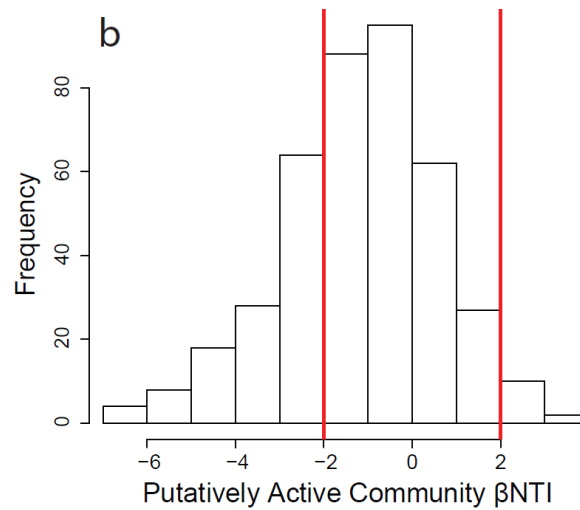
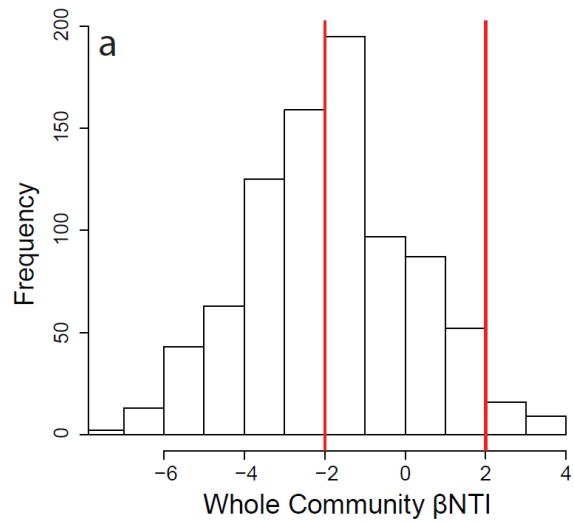


## Supplementary Materials

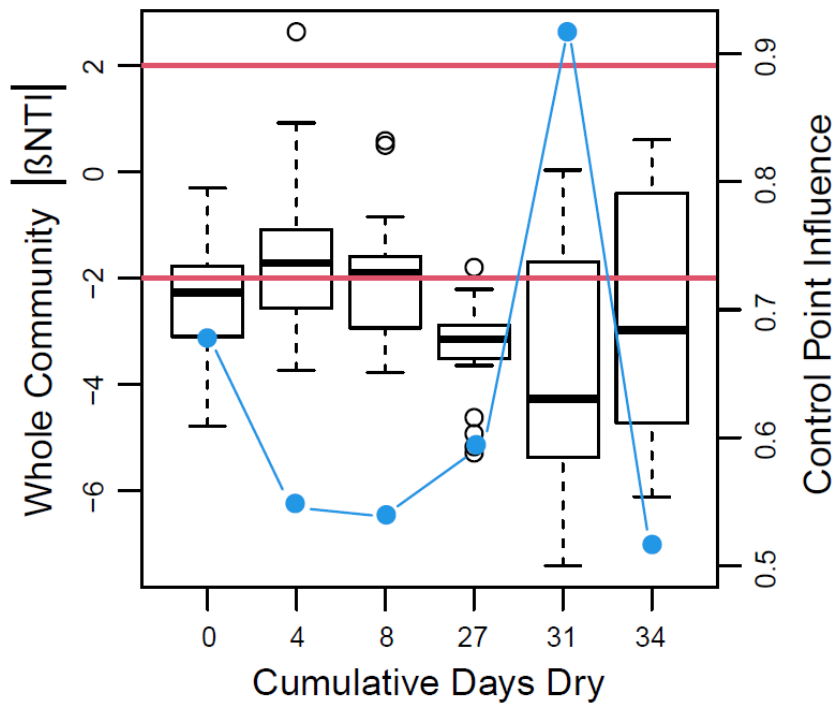


Data SIO, NOAA, U.S. Navy, NGA, GEBCO • Image Landsat / Copernicus • Data LDEO-Columbia, NSF, NOAA • Maps data: GOOGLE ©2021

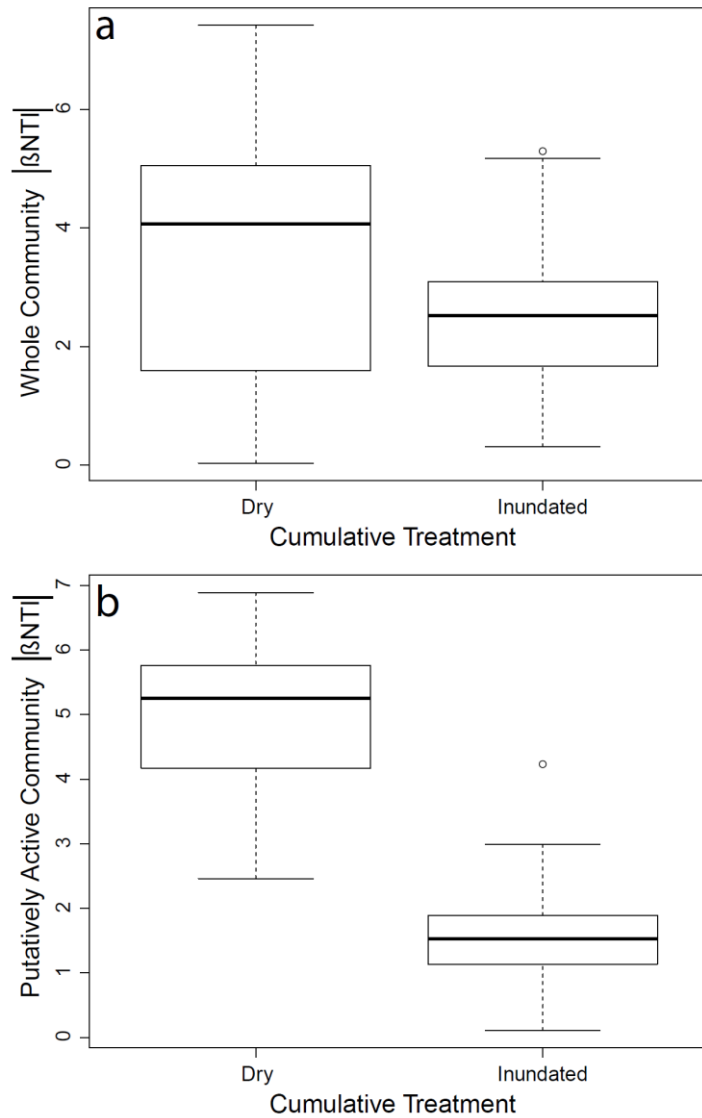
**Supplementary Figure S1. Field location from which sediments were collected.** The site is along the Columbia River in southeast Washington State, as shown in the bottom portion of the image. The system is characterized by variable inundation of the river bed sediments and associated hyporheic zone. The middle images emphasize this variability in inundation. In those images the dashed yellow line is in the same location and outlines the shoreline of an island that is exposed during low water and inundated during high water. The photo at the top of the image is from the location of sediment collection. As can be seen, the system contains large cobbles and gravels, which are partially responsible for high hydrologic conductivity within the hyporheic zone, resulting in aerobic conditions during both inundated and non-inundated conditions.



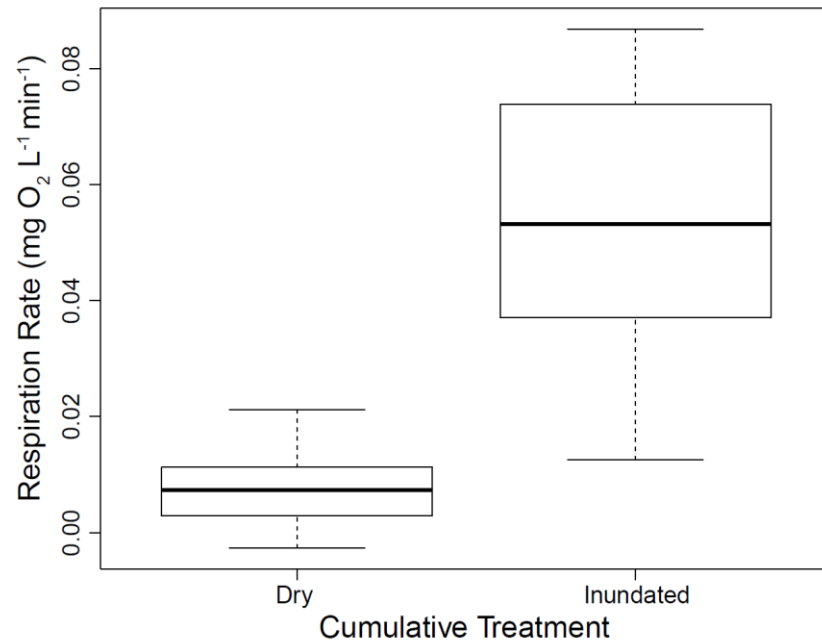
**Supplementary Figure S2. Histograms of  $\beta$ NTI associated with whole communities (a) and putatively active communities (b).** Vertical red lines are the significant thresholds (-2 and +2). Values below -2 indicate deterministic homogenous selection, values above +2 indicate deterministic variable selection, and values between -2 and +2 indicate stochastic assembly.



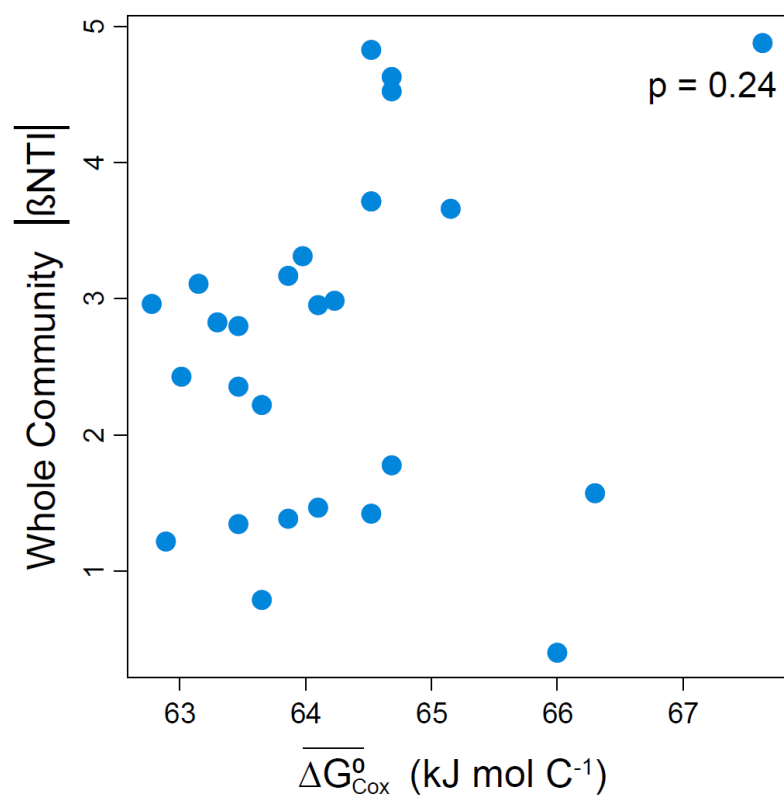
**Supplementary Figure S3. Boxplot representations of whole community  $\beta_{NTI}$  distributions as a function of the cumulative number of days reactors were in a dried state.** Each value along the horizontal axis represents a different experimental treatment. The right hand axis provides estimates of control point influence (blue circles and lines) across the treatments. Horizontal red lines indicate significance thresholds for  $\beta_{NTI}$ ; values below -2 indicate deterministic homogenous selection, values above +2 indicate deterministic variable selection, and values between -2 and +2 indicate stochastic assembly.



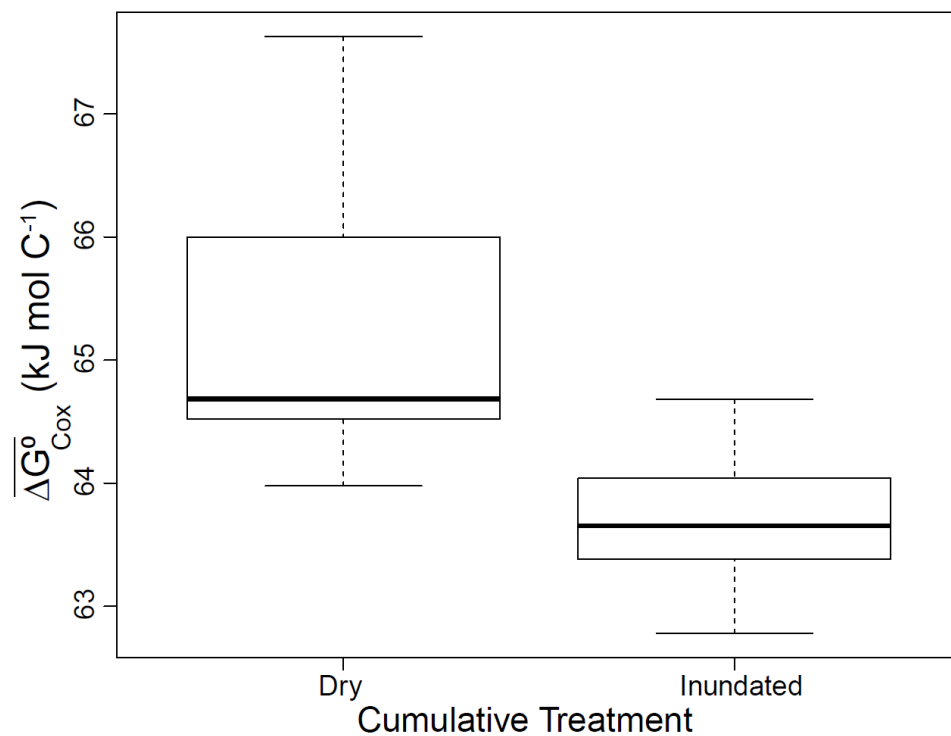
**Supplementary Figure S4. Boxplot representations of distributions of the absolute values of  $\beta NTI$  for the whole community (a) and the putatively active community (b) across two different categories of disturbance.** On the horizontal axis 'Dry' indicates data combined from across treatments with 31 or 34 cumulative dry days, while 'Inundated' indicates data combined from across treatments with 0-27 cumulative dry days.



**Supplementary Figure S5. Boxplot representations of respiration rate distributions across two different categories of disturbance.** On the horizontal axis 'Dry' indicates data combined from across treatments with 31 or 34 cumulative dry days, while 'Inundated' indicates data combined from across treatments with 0-27 cumulative dry days. The two distributions were significantly different per a pairwise Mann-Whitney test ( $W = 5$ ,  $p < 0.001$ ).



**Supplementary Figure S6. Community assembly as a function of organic matter thermodynamics.** The strength of deterministic assembly associated with the whole community as measured by  $\beta\text{NTI}$  was not related to organic matter thermodynamics.



**Supplementary Figure S7. Boxplot representations of organic matter thermodynamics across two different categories of disturbance.** On the horizontal axis, 'Dry' indicates data combined from across treatments with 31 or 34 cumulative dry days, while 'Inundated' indicates data combined from across treatments with 0-27 cumulative dry days. The two distributions were significantly different per a pairwise Mann-Whitney test ( $W = 189$ ,  $p = < 0.001$ ).

56 **Table S1. Time series of moisture content within vial batch reactors.** Columns indicate the  
57 date (month/day/year), sample name that maps to the metadata file found on ESS-DIVE, the  
58 number of inundated/dessicated transitions (referred to as cycles for compatibility with R  
59 Scripts provided in ESS-DIVE data package), the estimated dry sediment mass in grams, and  
60 the mass of water in grams per gram of dry sediment.