Modern Day Columbia River

Hydropower dams altered flows and sediment loading to the Lower Columbia River

"Greening of the river" implies that water column photosynthesis by phytoplankton has a larger role in ecosystem productivity in the modern day river







The Lower Columbia River

~ 200 km Tidal freshwater river system





The Lower Columbia River

~ 200 km Tidal freshwater river system

Portland and Vancouver metropolitan area



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The Lower Columbia River

~ 200 km Tidal freshwater river system
 Portland and Vancouver metropolitan area

Intertidal wetland habitat restoration



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Fig. 3. (a) Chlorophyll a concentration, (b) abundance, and (c) biomass of 6 major taxonomic categories of Columbia River phytoplankton collected near Vancouver, WA (USA), from January 2005 to December 2018



Seasonal blooms and diverse phytoplankton assemblage

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Seasonal and interannual variation in lower Columbia River phytoplankton (2005–2018): environmental variability and a decline in large bloom-forming diatoms

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LIMNOLOGY and OCEANOGRAPHY



Quantity and quality of particulate organic matter controls bacterial production in the Columbia River estuary

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Ecosystem-scale productivity





How can phytoplankton grow in a large flowing river?



Allan, J. D., Castillo, M. M., & Capps, K. A. (2020). *Stream ecology: structure and function of running waters*. Springer Nature.



Open water methods for measuring productivity



Is a fixed station representative of the river?





Evidence that the river is well mixed





Evidence that the river is well mixed







Direct measurements of production and respiration







Estimates of phytoplankton productivity on biogeochemical cycles



Effects of greening of the river on biogeochemical fluxes

		Bonneville	Satura OF	% Change
DOC (µmol L⁻¹)	Winter	112	300	
	winter	113	108	-4
	Spring	129	133	3
	Summer	189	191	1
	Fall	138	133	-4
		Bonneville		
		Dam	Saturn 05	% Change
Nitrate (µmol L ⁻¹)	Winter	30	32	5
	Spring	17	15	-11
	Summer	7	6	-15
	Fall	22	23	7
		Bonneville		
		Dam	Saturn 05	% Change
POC (µmol L ⁻¹)	Winter	20	15	-25
	Spring	45	53	19
	Summer	18	23	26
	Fall	18	13	-29



River flow 2010-2021 – Max, Min, Avg Units – 1000 m³/s



Large Freshet

Bonneville



BAT

Average Freshet



Small Freshet



River Temp – Large Freshet 2011,2017



River Temp – Average Freshet 2014,2020



River Temp – Small Freshet 2015,2021



days (May – Aug) when river temperature is > 19°C



Franz lake Temp – High Freshet



Franz lake Temp – Low Freshet

