THOMPSON RIVERS UNIVERSITY

A 'Teaching Toolbox' for Understanding Urban Wetlands

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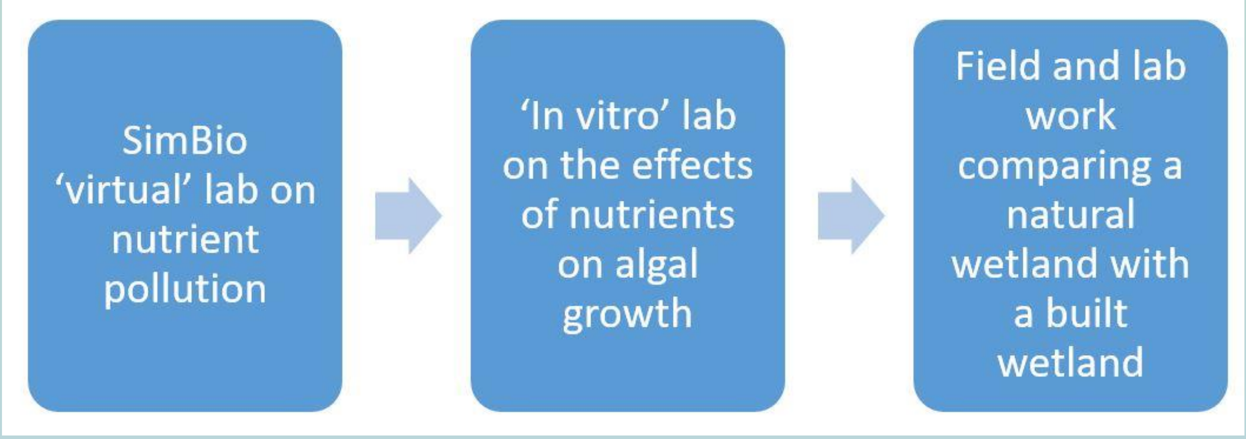
The Importance of Urban Wetlands

- Comprising only 1.5% of the Earth's surface, wetlands are extremely important ecosystems; they are often called the *kidneys of the landscape* due to their ability to improve water quality as well as being *ecological supermarkets* [1].
- On a global scale, wetlands are important carbon sinks and climate stabilizers. Urban wetlands are also sinks for excess nutrients used in an urban environment and they offer important water treatment capabilities for nutrient removal [2].
- Yet wetlands are one of the most threatened ecosystems on Earth and are disappearing at a rapid rate. Wetlands in urban areas are particularly at risk with 80% to 98% having been lost in Canada already [3].

3-step teaching toolbox



In a series of labs, undergraduate students in the non-majors Environmental Biology class learn about eutrophication and limiting nutrients, and how this applies to urban wetlands with a virtual lake model (1), 'in vitro' experiments (2) and hands-on field and lab research (3). The overall goal of these labs is to demonstrate the importance of urban wetlands, especially in regard to nutrient removal.

1 - SimBio Virtual lab

In this lab students complete the SimBio* 'Nutrient Pollution' lab (Figure 1) and learn about the connection between excess nutrients, algae and dissolved oxygen (DO) depletion, and the impact of this on aquatic food webs. Students also learn about limiting nutrients, and their impact on algal growth.

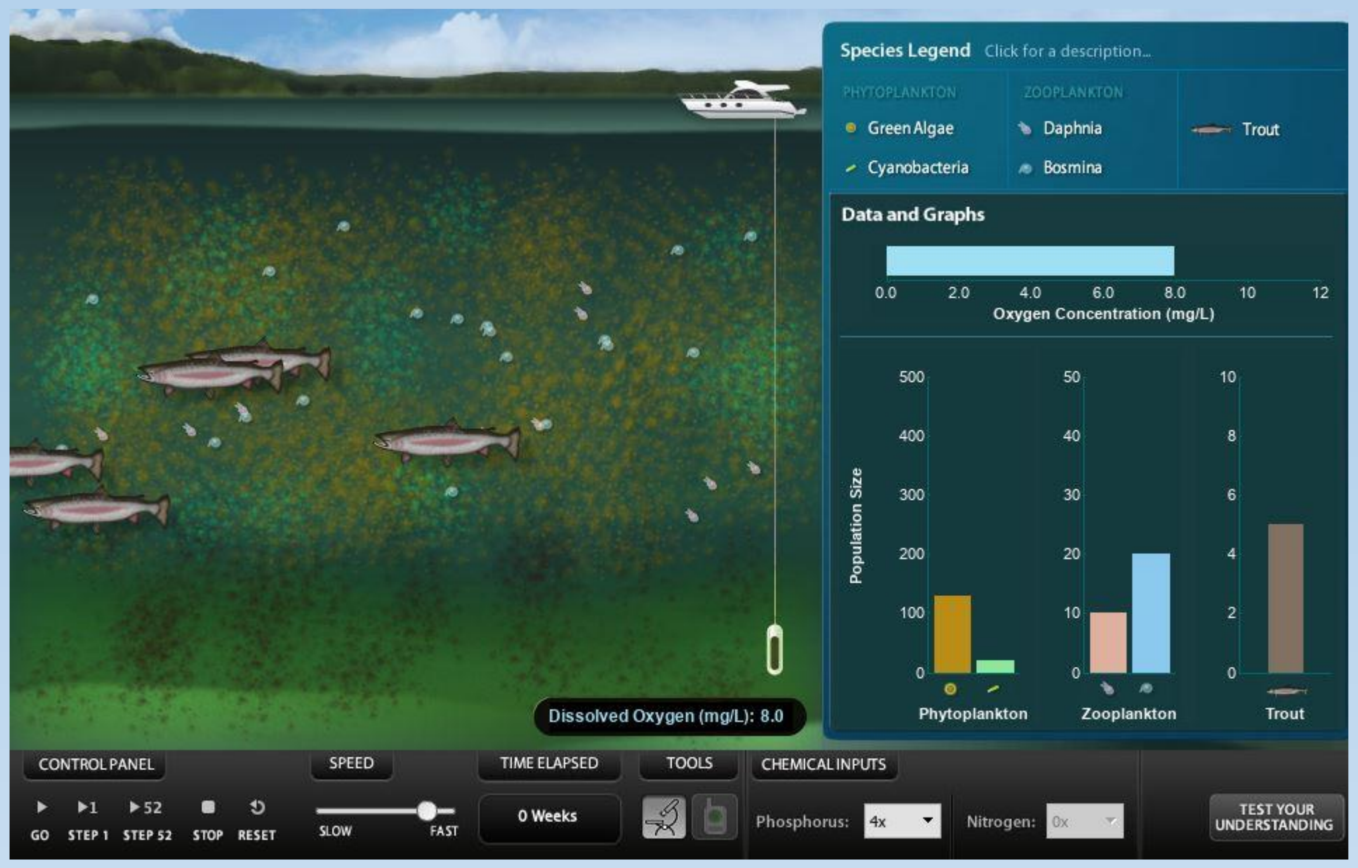


Figure 1. A screenshot from the SimBio Nutrient Pollution Virtual Lab
(*SimBio Virtual Labs TM: EcoBeaker ®2010, SimBiotic Softwear for Teaching and Research, Inc.)

2 -Testing Nutrient Limitation on Algal Growth

- The purpose of this lab is to see the effects of the two most important nutrients in aquatic ecosystems - nitrogen and phosphorus - on algal growth in oligotrophic water (collected from Kamloops lake) and in eutrophic water (collected from Dufferin wetlands).
- Nutrients are added to both types of water in 500 ml jars with the hypothesis that the oligotrophic water will experience the greatest percentage increase in algal growth due to the limiting nature of these nutrients in the water.
- Nitrate is added in the form of $NaN0_3$ (1,600 ug/l) and phosphorus in the form of NaH_2P0_4 (100 ug/l), singularly and in combination [4].
- After one week in an incubator at 28 C under 24 hours light the algal abundance is determined by measuring the chlorophyll *a* levels in each jar (using the ISO 10260 method). Results from May 2019 are shown in Figure 2.
- Students individually write a report on the class results and make conclusions as to whether these nutrients are limiting in either water body.

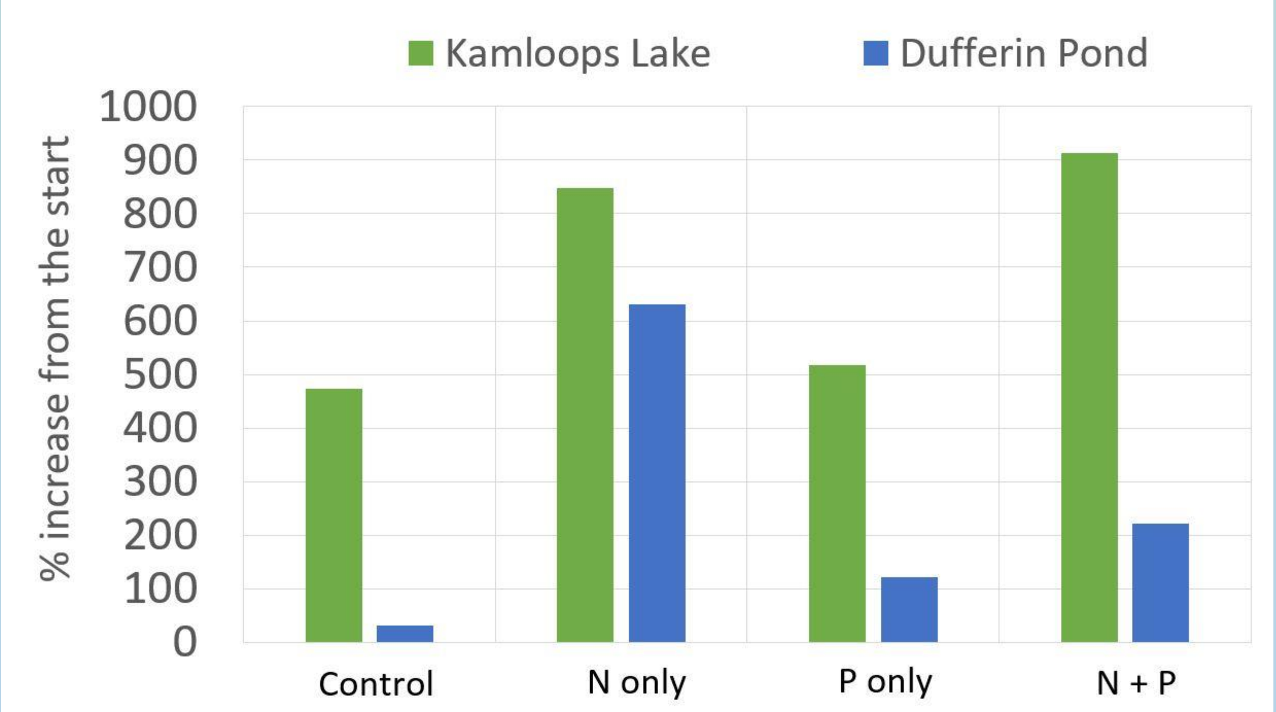


Figure 2. Percent increase in chlorophyll *a levels* in Kamloops Lake water (start: 3.3 ug/l) and Dufferin Pond water (start: 17.8 ug/l) with the addition of either nitrogen or phosphorus, or both, after one week at 28 degrees Celsius.

Figure 3. Collecting zooplankton in Gamble Pond, Kamloops, BC.

3 - Ecological Comparison of a Natural and a Built Wetland

Figure 4. Dufferin Park Wetlands, Kamloops, BC.

- The purpose of these labs is to compare a newly built wetland - Figure 4) with a natural wetland (Figure 3), both of which are situated within the city boundaries.
- Abiotic parameters which are measured in the field include DO levels, conductivity, and pH. Water samples are collected and the nitrate and phosphate levels are measured in the lab (Hach kit) and also for measuring chlorophyll *a* levels.
- Zooplankton are collected with a zooplankton net and sub-sampled and counted in the lab; the benthos is sampled using an Ekman grab, and the larger invertebrates are collected with D-frame nets and identified in the lab and scored using the Biological Monitoring Working Party (BMWP) Index where invertebrate families are scored 1 to 10 (lower numbers indicting pollution tolerance). See Table 1 for results.
- Students use the jointly collected and analyzed class data to individually write a report comparing the two ecosystems and also make conclusions as to the ecological health of each.
- Results are also shared with the City of Kamloops Nature Parks department for on-going monitoring of both wetlands.

Table 1. Abiotic and biotic results (Sept 2018) from a natural urban wetland (Gamble) and a newly built urban wetland (Dufferin).

Parameter	Gamble	Dufferin
Dissolved oxygen (mg/l)	10.3	7.2
Conductivity (ms/cm)	2.77	3.7
pH	8.33	8.33
Nitrate (mg/l)	0.132	0.308
Total phosphate (mg/l)	0.497	1.14
Chlorophyll *a* (ug/l)	4.81	25.4
Zooplankton (#/l)	118	38
Macro Invertebrate BMWP Index	4.5	4.2

References

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