Taking the pulse of freshwater ecosystems

ORC is using dissolved oxygen sensors to take the pulse of Otago streams. Measuring dissolved oxygen in freshwater gives an indication of the daily and seasonal cycles of stream ecosystems—and the science behind the process is fascinating.

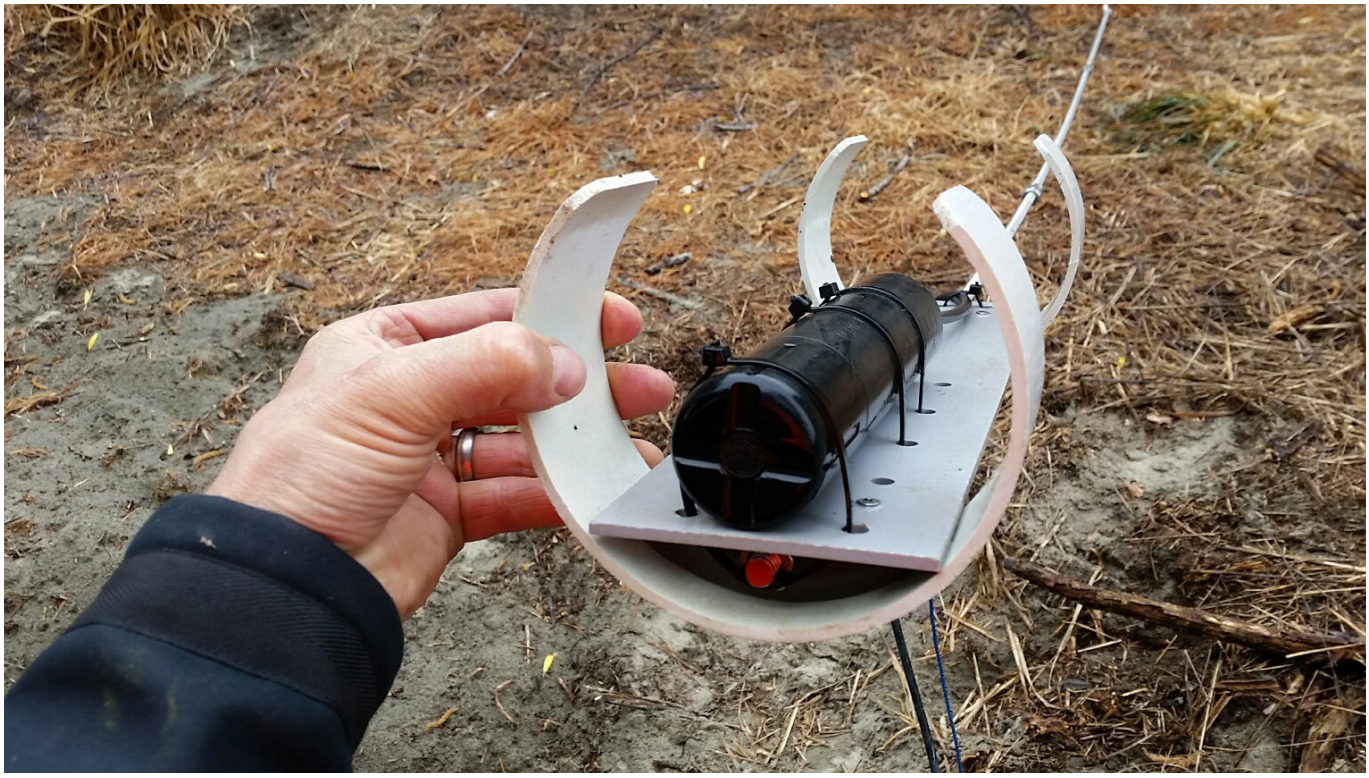
By monitoring the ebb and flow of dissolved oxygen in streams, ORC can gather data on what the "normal" seasonal patterns are, and identify when the energy in a stream ecosystem has changed. That makes it a valuable metric for measuring the health of our waterways.

"Anytime energy is used in an ecosystem, carbon dioxide or oxygen are involved—either produced or consumed. As a result, those concentrations are constantly being altered," explains Jason Augspurger, a freshwater scientist at ORC.

Typically, dissolved oxygen in the water will reflect a day-night pattern, as algae photosynthesise during the day—releasing oxygen—and respire at night, which consumes oxygen. The more algae present in the water, the bigger the range between levels of oxygen during the day and at night.

"When you start to build long-term datasets with this information, you can look at the seasonal and annual

An installed dissolved oxygen sensor in the Cardrona River.



A dissolved oxygen sensor in its purpose-built cradle.

variation in these patterns. Given you're measuring the energy use of the stream, a lot of people have likened it to taking the pulse of the stream," Jason said.

Each stream has a different oxygen "pulse", depending on a range of environmental factors. Jason gives the example of a stream with tree coverage.

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"It might not see as much sun during the summer due to the canopy of leaves, which will mean oxygen levels stay relatively stable. In autumn though, when those leaves drop into the water and are broken down by bacteria and invertebrates, you'll see quite a lot of oxygen being consumed and potentially very little being produced."

In comparison, a stream without canopy coverage will create a wider daily range of dissolved oxygen, as algae grows in warm summer conditions. Flood events also have an impact on dissolved oxygen.

"The first high flow event after summer will scour algae off the streambed, leading to smaller daily oxygen ranges, but then as the ecosystem recovers, we'll see that range increase again," Jason said.

Design and installation

The dissolved oxygen sensors sit in a pipe casing designed in-house by ORC staff to survive high-flow conditions. Paul Hannah and Eve Bruhns, two Senior Environmental Officers with ORC's environmental monitoring team, worked on the design and installation of the sensors.

"We knew the sensors had to survive serious flooding, so a fair bit of effort was made to armour them with heavy-walled PVC pressure pipe and sturdy fasteners. We also used long steel poles at each monitoring site to secure the pipes in place, even when bank erosion occurs during flooding," Paul explains.

The sensors require fairly regular maintenance and calibration, so they are fixed to a cradle that can be easily removed. They are also wired into data loggers that send information back to ORC via cell or satellite telemetry.

Paul notes that each site has posed its own challenges for the sensor design.

"We've found some of the sensors need to be cleaned more often due to algae growth. There are some sites where fine sediment is finding its way into the pipe housing, which needs to be cleared manually, and one site at Mount Barker with a very mobile riverbed, where the sensor gets buried from time to time during high flows."

"But they have all survived some pretty serious flooding in the last few months, which is a great sign, and the data they are delivering is invaluable."