

Modeled and measured currents and oxygen in tropical aquaculture

Barramundi fish is becoming a popular species in tropical water fish farms. This species is tolerant to warm waters and to relatively low levels of oxygen, but when O₂ drops below about 3 mg/l the growth rates will decrease and if the levels drop rapidly it could result in fish kills.

The scope of this study was to get a better understanding of the onsite oceanographic conditions that are the most important to the daily operations and on the environmental impact of the fish farm. Another aspect was to compare modeled currents, from a forecasting model, with measured.

Two Aanderaa SeaGuardII multiparameter systems were deployed around and inside the pens. In one upstream deployment, the first system was placed in a mooring upward looking close to the bottom. In another downstream deployment it was turned up-side-down close to the surface (Fig. [1]). The parameters measured were currents in the water column in 1m layers, waves, oxygen, salinity, temperature and turbidity. In addition a string systems to measure oxygen, temperature and salinity at two depths, 5 and 9m below the surface was placed inside one of the pens.

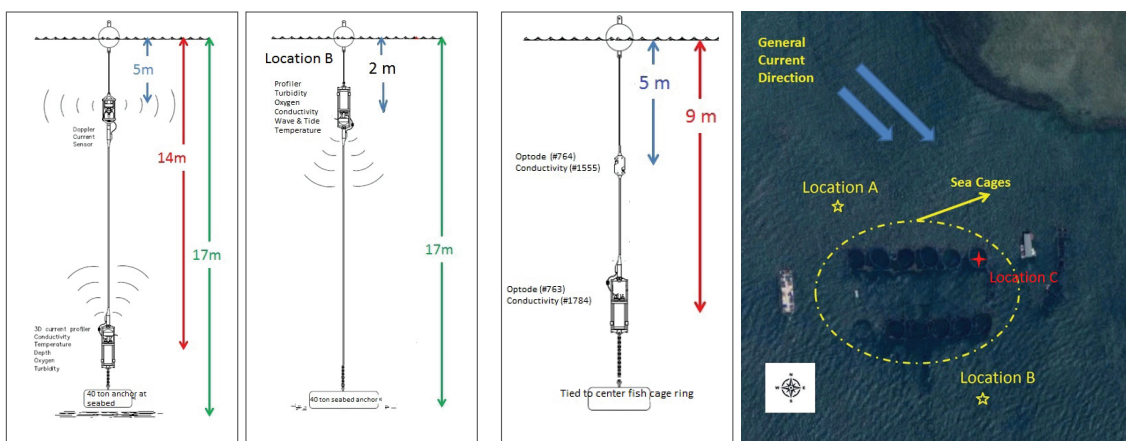


Barramundi Fish

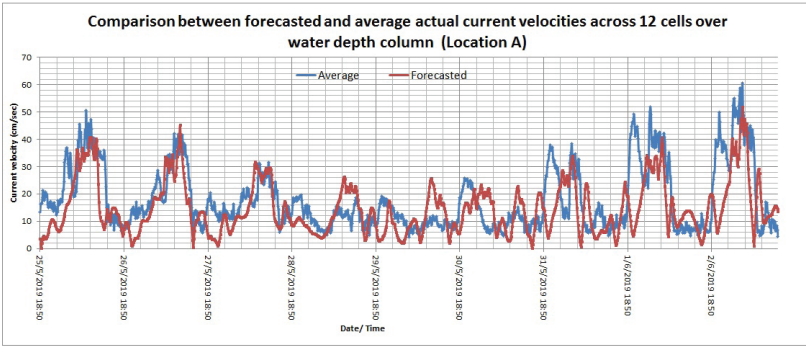
Oxygen levels in-side the pens are dependent on water circulation through and on local oxygen consumption by fish and by degradation of organic material from remains of fish food and excrement's (fecal pellets).

Results

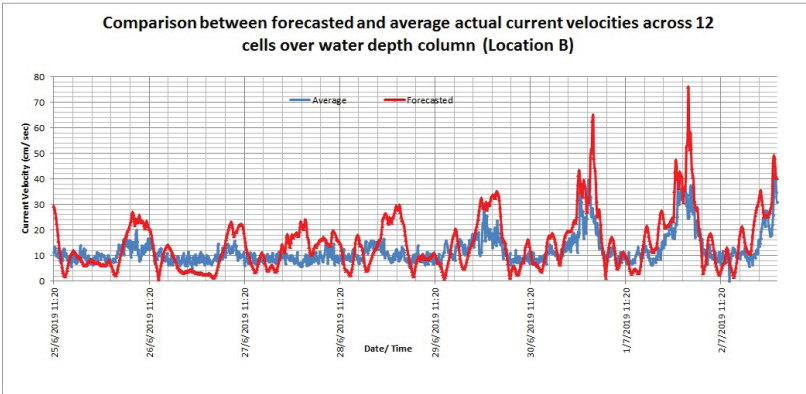
Results show that at this site currents are tidally driven with velocities between 0-100cm/s and with a quite uniform main water transport in the South-East direction throughout the water column. With the presence of sea-cages, there is an important decline in current velocities at Location B, downstream of the pens.



[1] Aanderaa SeaGuardII DCP set up and deployment at locations A, B and C. A and B are selected to assess the impact of sea cages on current velocities. The second system was placed inside one of the pens, location C (red), to monitor oxygen, salinity and temperature at 2 levels.



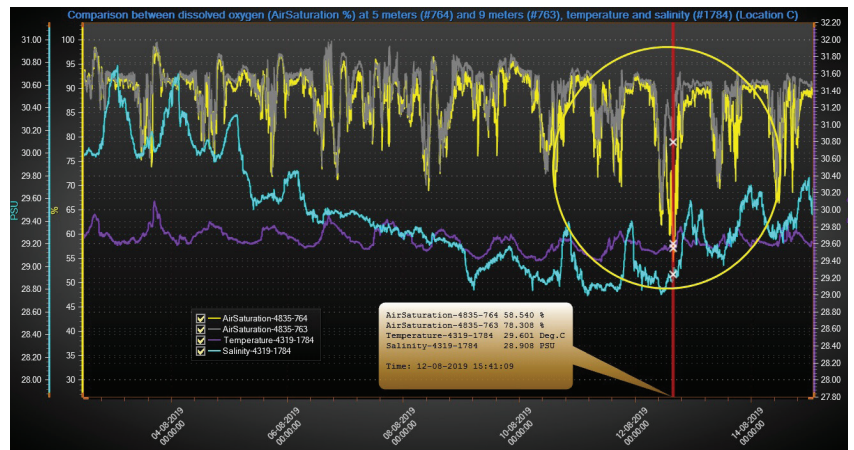
[2] Comparison between forecasted current velocities (red) and actual field measurements (blue) at location A and B.



At this site the fish farm operations team receives current information, averaged over the entire water column, from a model subscription. For comparison, flow velocities in all 1-m measured cells were averaged and compared against the model results (Fig. [2]). Upstream the fish farm modeled and measured velocities compare well but the model seems to underestimate at higher velocities. Downstream the model completely overestimates the velocities because it does not take into account the fish farm. At this site, with water transport in one main direction over the entire water column modeling is relatively easy. It would have been more challenging at a site where currents are going in different directions at different depths.

Dissolved Oxygen (DO), measured at two levels, varied mainly with tides between 60-100 % air saturation during the two-week deployment. There was a trend of lower DO at 5 meters compared to 9 meters. This is possibly due to accumulation of more fish at the shallower depth. The lowest oxygen levels were measured on August 12 when the concentrations were

at 3.88mg/l and 5.64mg/l at 5 meters and 9 meters, respectively. During the same period, temperature and salinity readings did not show any anomalies (Fig. [3]). This implies that the drop in DO levels might be due to poor exchange of DO between inside and outside fish cage. The large variability demonstrates the importance of continuous monitoring as opposed to spot measurements. In this case DO did not drop below critical levels but the monitoring period was short.



[3] Aanderaa string system with Oxygen, Temperature and Salinity monitoring at 2 depths, 5 and 9m below surface.

For more information and questions please contact us at aanderaa@xylem.com.

Aanderaa Data Instruments AS
 Sanddalsringen 5b, PB 103 Midtun
 5843 Bergen, Norway
 Tel +47 55 60 48 00
 Fax +47 55 60 48 01
www.aanderaa.com