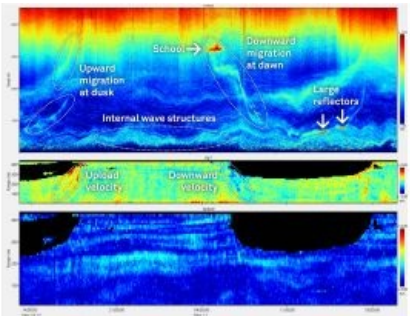
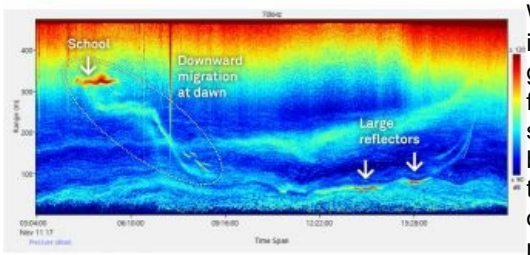
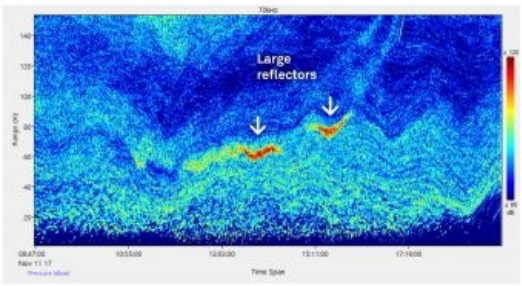
Keeping Fisheries Sustainable with Groundbreaking New Acoustic Technology





With fish and other marine life becoming increasingly important for feeding the growing human population, science-based fisheries management is crucial to keep stocks sustainable. How can acoustic-based scientific instruments contribute in this respect, while also opening up opportunities for interdisciplinary scientific research?



To keep stocks sustainable, fishery scientists and managers need to understand the dynamics and structure of fish stocks, as well as the resources those fish depend on. What scientific instrumentation can be used in this respect? Echosounders can help us quantify the biomass and behavior of fish, as well as the plankton and/or krill that many fish species eat. Acoustic Doppler Current Profilers (ADCPs), on the other hand, provide information about currents, which can shape the availability of plankton.

“It used to be that the biological oceanographers could work in one place, while the physical oceanographers worked separately somewhere else,” says David Velasco, lead author of a paper on a combined ADCP and biological echosounder system called Signature100 presented at the Oceans’18 MTS/IEEE Kobe/Techno-Ocean 2018 conference.

With fisheries management beginning to take on a more holistic ecosystem approach and funding becoming more limited, collaborations between physical and biological scientists are coming to fruition more and more. Scientific instrumentation therefore needs to follow suit to match these changing needs.

Providing the tools for collaborations between physical and biological scientists

The Signature100 lends itself well to collaborations between physical and biological scientists, since it uniquely combines the capabilities of an ADCP and a biological echosounder in one. It is currently the only instrument in the world providing this combined capacity.

“The biggest advantage of combining an ADCP and a single-beam wide-band echosounder as on the Signature100 comes down to costs and logistics,” says David Velasco.

Echogram (top), vertical velocity (middle), and horizontal current speed (bottom) for the first two days of the deployment.

“Currently, scientists wanting to study both physical and biological aspects need to purchase two separate pieces of equipment, each deployed separately. With the Signature100, however, instead of having to deal with two moorings and two separate installations, you just have one,” he adds.

Since the samples from the ADCP and echosounder are already accurately synchronized with each other in the one instrument, processing the data afterwards also becomes much more efficient.

Providing information on the movement of marine life

As reported in the IEEE paper, sea trials of the Signature100 in the Mediterranean Sea have demonstrated the high performance of this novel instrument. Focusing on the echosounder performance, a 70 kHz pulse (one of the three frequencies available in the system) was able to provide information on the movement of marine life.

Acoustically, a single fish can look very similar to a school of plankton of the same volume. For users to determine whether they are looking at one fish or a mass of plankton, and assess how big the individuals are, it is important they calibrate their echosounder for absolute backscatter.

For the purposes of this initial field test, the Signature100’s echosounder was not calibrated for absolute backscatter, but from the movement patterns seen in the echograms the team is confident they detected the migration of plankton up and down the water column. Nortek is currently developing a way for users to calibrate the echosounders to enhance the instrument’s identification potential.

Echogram of diel plankton migration.

Identifying internal waves in the ocean

For those more interested in physical oceanography, the Signature100’s echosounder beam used in the field validation in the Mediterranean Sea also identified internal waves towards the bottom half of the water column. Meanwhile, setting the ADCP to transmit 60 pings at 0.25 Hz on a 5-minute repeating sequence, and with a profile of sixty 10 m depth cells, the tested instrument was able to profile currents through a maximum usable range of up to 420 m.

Enabling long-term deployments for deeper scientific understanding

Although the field test lasted only five days, thanks to the low power consumption of the unit, in other deployments the Signature100 can collect data for up to a year. The data retrieved from such a long-term deployment can help scientists understand the seasonal dynamics of an area and play a role in understanding the longer-term impacts of climate change on the ocean and implications for fisheries management.

Strong reflectors showing denser concentration of plankton and/or fish.
