Developments in acoustic telemetry from Innovasea (Vemco) and RS Aqua

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RS Aqua and the recent growth of acoustic fish telemetry in the UK and Ireland

RS Aqua are the UK's largest supplier of marine science instrumentation, and for the past 7 years have been the exclusive technical and scientific agents for Innovasea (formerly Vemco) in the UK and Ireland. Vemco are the world leader in the development and supply of acoustic telemetry fish tracking technology.

The first part of this paper focuses on the role RS Aqua have played in fish telemetry research in recent years and describes some of the support they have provided to the SAMARCH study. The latter part of the paper takes a look at the cutting-edge technological developments in acoustic telemetry that Vemco plan to roll out in the coming years.

RS Aqua supplies marine science technology and expertise into four main sectors: Environment & Fisheries, Marine Science Research, Offshore Resources, and Marine Survey and Inspection. The company has experienced sustained growth in recent years and has witnessed a marked increase in acoustic telemetry fish tracking in the UK & Ireland. As Vemco's exclusive agent RS Aqua have developed considerable expertise in this research field, working closely with fisheries researchers to specify the correct Vemco equipment for their work. For many studies RS Aqua not only oversee the logistics of equipment supply, but also provide technical expertise on the positioning, deployment and recovery of acoustic receivers, and in some cases help with the data analysis. RS Aqua have dedicated scientific staff responsible for this work in fisheries telemetry and have developed close relationships with many of the researchers in this field. They also provide lifetime product support for all the Vemco equipment supplied.

The engineering team at RS Aqua are the inventors of the ARC Acoustic Release Canister, which allows the safe recovery of the seabed anchor when using Vemco's VR2AR acoustic release fish tracking receiver. The development of this system was started in 2016 by Marine Scotland in response to a Scottish marine licensing requirement that all seabed anchors should be removed at the same time as any science equipment to which they are attached. With support from RS Aqua, Marine Scotland constructed a stainless steel rope canister with floatation that could be attached to the Vemco VR2AR receiver and which allowed the hauling up of the seabed anchor once the VR2AR had risen to the sea surface. This system worked well but was prone to extensive corrosion. RS Aqua came up with a Delrin version of the canister and field tested several prototypes throughout 2017 with the support of Marine Scotland. The ARC unit has been modified several times since then and it is now available in 4 different sizes and uses almost no metal parts whatsoever. Throughout its development and beta testing process the unit maintained a 100% successful recovery rate, and there have now been over 360 ARCs supplied to fisheries researchers in the UK, Ireland, Canada and the USA (including NASA!) The ARC has been a key part of several large acoustic telemetry fish monitoring projects e.g. COMPASS in Ireland and the Missing Salmon Project in the Moray Firth.

Figure 1: ARC systems with Vemco VR2AR receivers being prepared for deployment. Photo credit Rob Main, Marine Scotland.

Through their fish telemetry work RS Aqua have built up a fish tracking database which records all historical acoustic telemetry projects in the UK and Ireland. This resource allows researchers to see the location of multiple acoustic telemetry receiver arrays concurrently and judge whether these arrays could provide additional detections of tagged fish being released in other locations. The database has contributed to several research funding applications and is currently being built into an online and freely available geographical information system (GIS).

As demonstrated by the development of the ARC, RS Aqua's ability to work closely with fisheries researchers and understand the technical challenges they face can lead to the development of game changing technology. For the SAMARCH researchers this led to the provision of two real time detection receivers which operate on the Vemco 180 kHz telemetry system. These systems are the first of their kind in the world, and they allow the SAMARCH team to receive text message alerts as their tagged fish return to their home rivers. Some of these fish are carrying data storage tags (DSTs) which have recorded temperature and pressure data throughout the fish migration. Being alerted to the animal's return in real time means the SAMARCH team can get to fish's location quickly and safely electro-fish the animal and remove its DST tag, or activate traps on the river to hold the fish in particular zone until the team arrives.

The SAMARCH team had been talking to RS Aqua about this requirement for several years, whilst at the same time Vemco had developed various real time data transmission systems operating on at 69 kHz frequency. After input from RS Aqua, in early 2019 Vemco put together the first 180 kHz real time systems which were supplied to Celine Artero at SAMARCH. The systems have been successfully operating on the Frome and Tamar rivers since early summer 2019.

Future technologies from Vemco

The provision of these real time systems to the SAMARCH team is a good example of Vemco's enthusiasm to support researchers through the provision of new acoustic telemetry solutions. This can also be seen in a series of forthcoming hardware and software developments planned by Vemco as part of their Fathom range. Fathom is a suite of capabilities that will allow researchers to interact with both their Vemco acoustic telemetry equipment and their detection data for advanced study management and data analysis purposes. Five applications of Fathom are currently planned: Fathom Live, Fathom Mobile, Fathom Connect, Fathom Central, and Fathom Position.

Fathom Live provides users with real time detection, in a similar fashion to how SAMARCH's real time system works. It consists of a digital receiver cabled to a weatherproof surface telemetry unit with WiFi or Satellite communications. This system sends tag detection data in real time from the receiver to a secure online portal. This portal is intuitive and user friendly and allows the user to set up alert parameters and view basic statistics on their detection data.

Vemco's new wireless aquaMeasure environmental sensors can also be integrated into Fathom Live. AquaMeasures measure various underwater parameters, e.g. Temperature, Dissolved Oxygen, Salinity, Chlorophyll, and then transmit those measurements acoustically through the water column, in a similar fashion to a Vemco fish tag. When used as part of a Fathom Live system, aquaMeasures allow researchers to have a real time overview of animal detections and the environmental conditions in the detection zones.

Fathom Mobile is a smartphone app that allows researchers to offload animal detection data from their Vemco receivers directly to their phone in the field. Further, Fathom Mobile will immediately back that data up online, providing an enhanced level of data security should any data get lost or equipment damaged. The app will also display receiver health data and provide metadata management tools for receivers and tags.

Fathom Connect is a PC software interface that allows users to connect to their receivers, configure them and offload detection data. It is already being used with Vemco's 180 kHz High Resolution system, due to its ability to deal with the much higher amount of detections recorded by those receivers. Vemco's existing software platform (VUE) does not have the ability to process these larger datasets and Fathom Connect in conjunction with Fathom Central is set to replace VUE for all Vemco receiver types in future. It will allow researchers to work with much larger datasets across existing and forthcoming Vemco receivers and provide new data analysis and visualisation tools. Using Fathom Central researchers will be able to visualise arrays within a GIS, and the detection loads of each receiver in the array. It will also allow the easy conversion of detection datasets to formats such as CSV so further analysis can be carried out in other software.

Fathom Position will allow researchers to carry out their own fine-scale positioning analysis of their detection data, as an alternative to the in-house Vemco Positioning System (VPS) analysis service that has been successfully operating now for many years.

Vemco will soon be releasing a new 307 kHz telemetry system which will be capable of fish tracking in the vicinity of large anthropogenic noise sources e.g. around hydropower structures. The 307 kHz tags are much smaller than those currently used by the 69 and 180 kHz systems, and the first of these will measure 3 mm diameter by 15 mm length. This system will allow the detection of hundreds of tags at the same time and provide precise time of arrival data for the ultra-fine scale positioning of tags.

Vemco has recently developed and made available several new sensor tag types, including its smallest ever sensor tags at 7 mm diameter. Acoustic Data Storage Tags (ADSTs) which continually measure, and store temperature and depth data are already available from Vemco in 9 and 13 mm diameter form factors, and in positively and negatively buoyant versions. These tags will transmit environmental data when within range of Vemco receivers, but otherwise need to be recaptured to offload their complete dataset.

The Vemco patented Predation / Digestion tag is now available in 69 and 180 kHz transmission versions and will soon be incorporated into the 307 kHz system. These patented tags change their transmission protocol when in contact with the stomach acid of an animal predator, providing a direct measure of predation. The new transmission also includes the time that has elapsed since predation occurred. These tags are currently available in 5, 7 and 9mm form factors, and can be combined with temperature measurement in the 69 kHz 7 and 9mm versions.

In addition to the above technologies, Vemco is continuing to develop its online support service at www.support.vemco.com. Users of this support service have access to a wealth of technical support information and can contact the Vemco support team directly there as well.

The quick and helpful support of Vemco users is of primary importance to both Vemco and RS Aqua, and going that extra mile for researchers forms a central part of the philosophy of both companies.