Mathematical analysis of harbour porpoise (*Phocoena phocoena*) echolocation feeding patterns

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North Sea harbour porpoises (Cetacea: *Phocoena phocoena*) are currently threatened by starvation, climate change, unsustainable incidental catches in fishing gear, pollution and potential exclusion from foraging habitat by offshore oil and gas activities[1-5]. It has long been established, however, that offshore oil and gas installations and their associated 500 m fishing exclusion zones, act as artificial reefs that provide habitats for fish, coral and other species assemblages [6-8]. Harbour porpoises use sound (echolocation) to navigate, communicate and catch prey[10] and by listening to their underwater click patterns, they have recently been shown to forage within 300 m of installations, predominantly at night[9], but it is not known whether they target installations as foraging locations.

When foraging around North Sea offshore installations they also show marked diel (24-hour) echolocation behaviour[9] that may reflect elevated prey species availability. Using previously published field data on porpoise foraging behaviour and diet and fish behaviour and abundance around offshore installations, we hypothesise that harbour porpoise acoustic activity is higher around a newly-established jack-up rig than at a control location in the open sea. From these data we predict that porpoise proxy feeding behaviour is also be elevated at night. To test this prediction, we monitored porpoise acoustic presence at both a rig and at a control location in a heavily industrialised region of the North Sea. We moored two autonomous porpoise echolocation click detectors (T and C-PODs) in an open sea control location and another two T/C-PODs from the side of a newly placed jack-up rig, 3 km away from the control site.

Very little is known about the nature of porpoise echolocation clicks, and new findings are being reported yearly. Specifically, publications using T/C-POD data are scant, and often misrepresented, due to a fundamental lack-of-understanding on how T/C-POD works and thus how click data can be analysed objectively.

Funding is sought to analyse T/C-POD data in a completely different light to conventional biological statistical analysis. Specifically, using existing numeric variables on porpoises echolocation click patterns, we'd like to

(a) develop an algorithm that sorts and processes raw click data quickly, and divides click patterns into meaningful data; and,
(b) Challenge existing accepted click parameter variables for T/C-POD raw click data based on new empirical field measurements.

This is a new collaboration between the Director of Ocean Science Consulting (OSC) Ltd., (Dr. Victoria Todd), as the sole funding organisation of the Ph.D., the Ph.D. student (Ian Todd) at ISVR and Dr. Max Ruffert (Edinburgh University). The project is a precursor to an anticipated long-term interaction between all three institutions, which is achievable in a relatively short time frame.