

## INSIDE JEB

## Echolocating porpoises fine-tune clicks to their surroundings



Freja echolocating in the sea pen at Fjord&Bælt. Photo credit: Michael Ladegaard.

Disarray is everywhere, from the dense rainforest canopy to your messy teenager's chaotic bedroom. But, clutter introduces an additional level of complication for creatures that depend on echolocation to negotiate their environment. Objects that are of no interest to the echolocating animals throw up confounding echoes, so how do harbour porpoises (*Phocoena phocoena*) adjust their echolocation clicks in different surroundings when assailed with a range of distracting reverberations?

Fortunately, when the question occurred to Michael Ladegaard and Peter Madsen from Aarhus University, Denmark, Fjord&Bælt (a research and experience centre in Denmark) was preparing to relocate its resident harbour porpoises – Freja and Sif – for 2 weeks from their spacious net pen in the Kerteminde Fjord to a 10 m long temporary oval pool on land while their fjord home was renovated. Realising that the opportunity

would allow them to compare directly the echolocation clicks produced by the porpoises in the relatively natural pen with those emitted in the more confined pool, Ladegaard and Madsen began training the mammals to echolocate blindfolded toward an aluminium cylinder, rewarding the mammals with a tasty fish each time they reached the cylinder after an 8 m approach.

The duo recorded over 161,000 clicks produced by the porpoises as they advanced toward the cylinder with a SoundTrap digital audio workstation concealed within the aluminium cylinder and a hydrophone mounted on each porpoise's body. Analysing the pressure profile of the sound wave arriving at the SoundTrap, the duo eventually selected 869 clicks that had been produced when the animals were head-on to the aluminium cylinder, before calculating the distance to the porpoise. Plotting the delay between clicks (the interclick

interval) against the porpoise's distance from the cylinder, Ladegaard and Madsen realised that the porpoises were clicking faster in the pool (approximately once every 35 ms), in contrast to every 60 ms in the more spacious sea enclosure. And when they compared the volume (sound level) of the clicks in the two locations, the porpoises were clicking more softly in the enclosed pool than in the open water sea pen.

The porpoises were fine-tuning their clicks depending on the environment in which they found themselves, clicking more slowly in the spacious sea pen – to allow sufficient time for extraneous echoes generated by more distant objects to return to them – in contrast to their brief sojourn in the more restricted pool, where distracting echoes returned more swiftly, allowing them to click faster. In addition, the porpoises turned down the volume in the enclosed pool, to reduce the impact of reverberations from the pool sides. 'For 60 years, researchers have mainly focused on how toothed whales adjust to a target of interest, but here we show that they need to negotiate an actively generated auditory scene consisting of much more than that single target and, therefore, also adjust their sampling to those "extraneous" echo generators', says Madsen.

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