

## INSIDE JEB

## Porpoises have higher metabolic rates than thought to keep warm in cold water



Porpoises in a sea pen at Fjord&Bælt, Denmark. Photo credit: Peter Verhoog and Fjord&Bælt, Denmark.

When humans are suddenly immersed in 5°C water the clock is ticking. They have at most 20 min before beginning to lose strength and coordination as the warmth leaches from their bodies. Yet many mammals, such as whales and porpoises, survive perfectly well in frigid waters, thanks to a thick thermal blanket of insulating blubber beneath the skin. In addition, Laia Doñate-Rojano and Peter Madsen from the University of Aarhus, Denmark, wondered whether the aquatic mammals may also be able to generate more warmth than similarly sized land mammals, as they had noticed that the animals in Danish coastal waters consume up to 550 small fish per hour. Yet previous research had suggested that the porpoises' metabolic rates were no higher than those of similarly sized land mammals. Unconvinced, Doñate-Rojano and her colleagues developed a new technique to measure metabolic rates in wild harbour porpoise (*Phocoena phocoena*) in order to find out whether they are boosted to keep the animals warm.

Working with a small pod of captive porpoises at Fjord&Bælt, at the entrance to the Kerteminde Fjord, Denmark, Doñate-Rojano, Gitte MacDonald and other colleagues kept track of the animals' daily food intake, while also calculating the amount of carbon dioxide produced by one of the animals to estimate its metabolic rate. But in order to measure the metabolic rates of wild porpoises, Doñate-Rojano knew that she would have to correlate the metabolic rates that she measured with the animals' breathing patterns. 'We sat on a high balcony from which we could observe how the porpoises swam, reached the surface and opened their blowhole to breathe', says Doñate-Rojano. After spending 24 hours with student helpers counting the animals' breaths when they surfaced, she was able to calculate the captive animals' energy use per breath. Then, she headed into the local waters in a fishing boat with Danuta Wisniewska, Mark Johnson and Jonas Teilmann to tag porpoises that had become

accidentally entangled in the nets with sound recorders so that she could listen to their breathing and calculate their metabolic rates. 'Counting every single blow in hundreds of hours of sound data was very laborious', she recalls.

After four years of porpoise rescue missions, the team was finally able to calculate the wild animals' metabolic rates and they were impressed to see that they ranged from 7.8 to 31 MJ day<sup>-1</sup>; more than double of that of similarly sized humans. In addition, the voracious appetites of the captive animals increased between July and November, when the porpoises accumulate blubber in preparation for winter. Rojano-Doñate also realised that the animals' metabolic rates did not vary much from season to season; the animals stockpiled additional energy during the summer, when they required less energy to maintain their body temperature, in the form of blubber in readiness for winter. However, when she calculated how long a starving porpoise could depend on its blubber for survival, she was shocked to discover that they could survive for as little as a week. 'It really highlights what a knife edge these animals live on', says Madsen, and he warns, 'because porpoises fuel their high metabolic rates with small fish, they need to hunt a lot of the time and have little resilience to human disturbance'.

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Rojano-Doñate, L., McDonald, B. I., Wisniewska, D. M., Johnson, M., Teilmann, J., Wahlberg, M., Højer-Kristensen, J. and Madsen, P. T. (2018). High field metabolic rates of wild harbour porpoises. *J. Exp. Biol.* **221**, jeb185827.

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