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INSIDE JEB

Weddell seal pups keep swimming when trading in fluff to cut costs

A Weddell seal pup (right) with its mother (left) in a breathing hole in the Antarctic fast-ice. Photo credit: Linnea Pearson (NMFS permit #21006-01, ACA permit #2018-013 M1)

Open water swimming is not for the faint hearted, especially when air and water temperatures tumble. But spare a thought for furry Weddell seal pups born on the Antarctic sea ice. Although their blanket of fluffy insulation works fine when dry, as soon as the pups plunge into the sub-zero waters, all benefits are lost. And the youngsters can take to the water learning to swim and dive as early as 2 days old. So, how do the seal pups cope when they shed their fur, relying instead on their developing blubber stores for insulation? 'We aimed to understand how pups stay warm on ice and in water and if older pups with more blubber use less energy to stay warm in the water', says Linnea Pearson from California State Polytechnic University (Cal Poly), USA, who headed south with Emma Weitzner, Lars Tomanek and Heather Liwanag (also from Cal Poly) to the McMurdo Station in Antarctica – close to a colony of Weddell seals – to monitor newborn pups through the first weeks of life.

'Weddell seals are relatively calm, which makes working with them easier', says Pearson, who weighed and measured the pups while also noting the condition of their fur as they moulted and became sleeker over a 7 week period. In addition, the team placed the pups inside a custom-built plastic chamber to measure their oxygen consumption when on the ice. Then, they removed the youngsters and pumped sea water into the chamber up to the height of each pup's chest before returning the youngsters to find out how their metabolism changed when immersed. 'You could tell most were already familiar with that environment', says Pearson. 'One kept blowing bubbles under the water. While cute, we had to get it to stop to get our data', she chuckles. In addition, the team tracked how often and for how long each pup went for a dip by tagging the youngsters' hind flippers before returning them to their mums.

Back in California, the team calculated the pups' metabolic rates when dry on the sea ice and sure enough, as the pups grew, their metabolic rates increased. However, when immersed in water, the 3- and 7-week-old pups had similar metabolic rates. 'This may represent a maximum thermal response of pups to submergence in water', says Pearson, adding that the youngest animals may be diverting more of their resources to speed up their moult and build up their blubber insulation faster.

However, when the team compared the metabolic rates of the youngest seals before they moulted, during the moult and after, they found clear differences at each stage. The pre-moult pups had the highest metabolic rates when immersed, consuming ∼13.4 ml O_2 $min^{-1}kg^{-1}$, compared with ∼9.4 ml O_2 $min^{-1}kg^{-1}$ when dry. Yet, while moulting and by the time the time the pups had discarded their fur, their metabolic rates when immersed had declined, eventually reaching ∼8 ml O_2 $min^{-1}kg^{-1}$. In addition, the fully moulted youngsters expended the same amount of energy when immersed and on the sea ice; they were no longer working hard to keep warm in the chilly water.

The team then compared how much time the youngsters were spending in the water before, during and after moulting, and were astonished that the moulting pups were spending three times as much time swimming as they did before and after the moult, even though they were expending more energy to remain warm in the water. The team suspects that the swimming and diving experience they gain while moulting may justify the expense, setting the youngsters up for a life of self-sufficiency when finally abandoned by their mothers.

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Pearson, L. E., Weitzner, E. L., Tomanek, L. and Liwanag, H. E. M. (2022). Metabolic cost of thermoregulation decreases after the molt in developing Weddell seal pups. *J. Exp. Biol.* **225**, jeb242773. doi:10.1242/jeb.242773

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