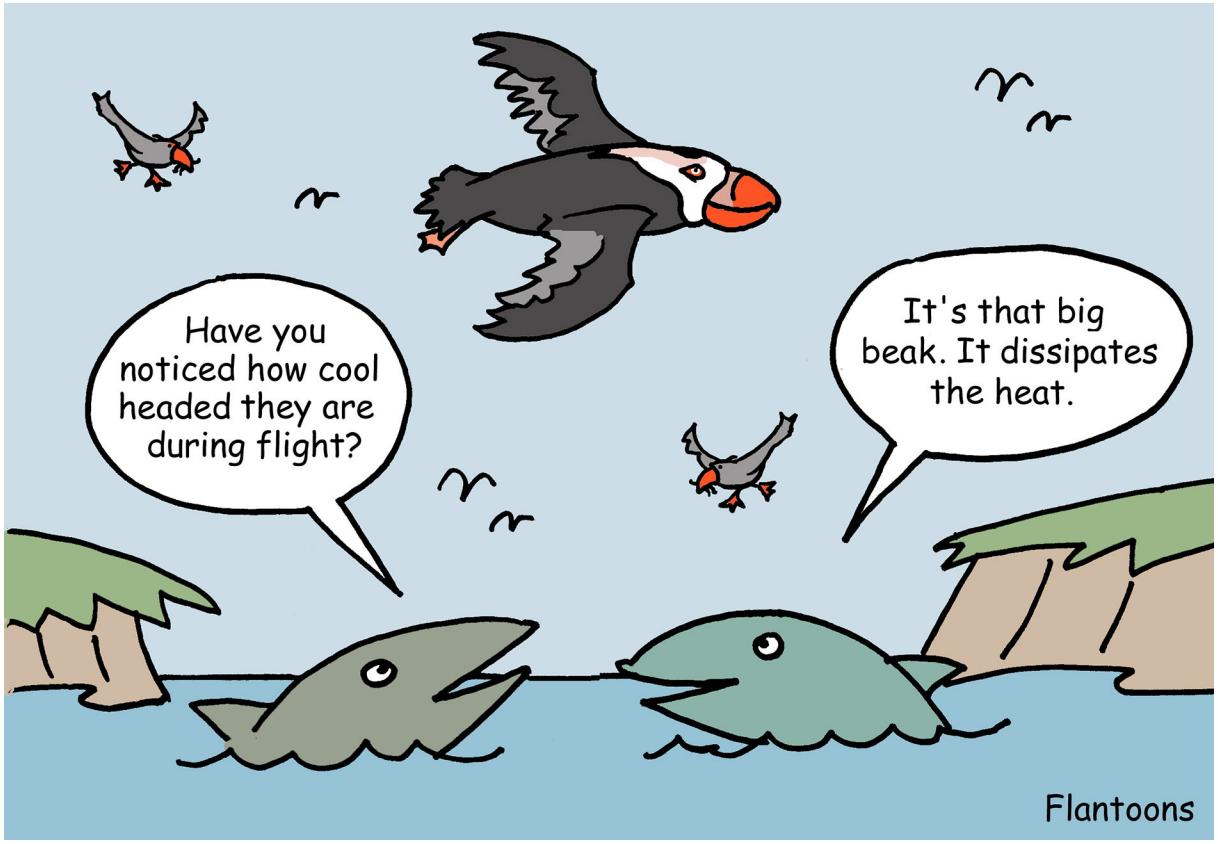
INSIDE JEB

Tufted puffin beaks are impressive radiators



Getting hot is a natural side effect of exercise and many animals have evolved strategies for dumping excess heat, from panting to sweating. But losing heat is particularly challenging for birds. Wrapped in a coat of insulating feathers, they can record some of the highest metabolic rates measured and generate colossal amounts of heat when they fly, which can put them at risk of overheating. However, Kyle Elliott from McGill University, Canada, explains that some birds are able to dissipate heat through their beaks. 'Bills have lots of blood vessels but no insulation, so they can shunt extra heat away from the body', says Elliott. Knowing that the largest members of the puffin family, tufted puffins (*Fratercula cirrhata*) are likely to have to work harder than most to remain airborne, Elliot wondered if the birds' relatively large beaks might be acting like radiators to keep their temperature down after they return from a flight.

To test the theory, Elliot and graduate student Shannon Whelan needed a way of recording the birds' beak and body temperatures when they returned to land from foraging trips. Fortunately, at the time, Whelan's partner, Hannes Schraft, was taking thermal shots of rattlesnakes with an infrared camera at San Diego State University and University of California, Davis, USA, so he joined Elliot and Whelan on Middleton Island, Alaska, with the camera to capture the birds' returns.

Taking thermal images every 2 min after the puffins landed, the team saw the birds' beaks cool from ~25°C to ~20°C over 30 min; in contrast, their temperature on the outside of their feathers barely changed at all. And, when they calculated how much heat was radiating from the birds' beaks, it was almost 20% of the total over the animal's whole body, even though the beak makes up only 6% of the bird's surface area.

Schraft suspects that dumping heat from the beak could allow the birds to sustain the massive energy outputs that are necessary to keep them aloft. Whelan adds, 'High energy expenditure during flight might have led to the evolution of large bills in puffins even though they should have small bills [to conserve heat] given the cold climates that they live in'.

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Schraft, H. A., Whelan, S. and Elliott, K. H. (2019). Huffin' and puffin: seabirds use large bills to dissipate heat from energetically demanding flight. *J. Exp. Biol.* **222**, jeb212563. doi:10.1242/jeb.212563

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